Fabrication of copper en copper semis in developing countries

Vingerhoets, J.W.A.

Publication date:
1986

faculteit der economische wetenschappen

RESEARCH MEMORANDUM

[redacted]

ILBURG UNIVERSITY
EPARTMENT OF ECONOMICS
ostbus 90153 - 5000 LE Tilburg
etherlands

FABRICATION OF COPPER AND COPPER SEMIS IN DEVELOPING COUNTRIES

A review of evidence and opportunities

by

Jan Vingerhoets

January 1986

CONTENTS

FOREWORD

In the fall of 1983 the Technical University Eindhoven and Tilburg University started a co-operative project on the "fabrication of copper semi-products in developing countries". The project is an in depth case-study of resource based industrialization in developing countries. The copper sector was selected because copper is a very important mineral export product of the developing countries and because a copper fabricating industry, producing semi-manufactures, can clearly be identified.

Particularly in the large copper exporting countries (Peru, Chile, Zambia, Zaïre) copper ore goes through several stages of processing and is mainly being exported in the form of blister and refined copper. Until the present time, however, these countries export very limited amounts of copper semi-manufactures. The objective of our research is to investigate if and under what conditions the copper exporting developing countries could produce and export certain copper semi-manufactures on a larger scale. The research concentrates on primary fabrication of copper and copper alloy semis. Four groups of products can be distinguished: wire rod; rods, bars and sections; plates, sheets and strips; tubes.

In order to determine the viability of export-oriented copper fabrication in developing countries, be it for regional or overseas markets, one has to investigate: the production processes and production costs in the industrialized countries, the import barriers in potentional export markets (including developing countries), marketing requirements and transport costs, and finally the feasibility of efficient production in developing countries. The general set-up of our research project has been a first stage with an investigation of existing international trade patterns and trade barriers (desk research) and of production and marketing of copper semis in Western Europe (through intensive contacts with a number of companies). This research is partly still going on at present. The second project stage is to investigate the feasibility of export-oriented

copper fabrication in Zambia and in Peru. These two countries have been selected because they are at different levels of industrialization.

This report is a review and analysis of the available statistics on international production and trade patterns and of the literature that tries to explain the changes in the geographical location in the copper sector (mining, metallurgy and semis fabrication) that did take place during the past decades. Thanks are due to Jo Meerding for his assistance in collection and compilation of statistics and to Jan Marijnissen, Ph.D. (Eindhoven University of Technology) for his valuable comments on an earlier draft of this report.

Jan Vingerhoets *

* Dr. Jan Vingerhoets is senior lecturer in Development Economics at the Economics Faculty of Tilburg University

INTRODUCTION

Over the past 15 to 20 years the developing countries have easily maintained their traditional role in the world copper industry: suppliers of raw materials for the industrialized countries. Contrary to the expectations of several analysts, the developing countries have increased their share in world mine production of copper. The wave of nationalizations in the sixties did not result in the developing countries becoming marginal suppliers of last resort. On the contrary, the share of the developing countries in the copper mine production of the market economies has increased spectacularly in recent years.

In the traditional copper producing countries the expansion of the production of blister and refined copper could keep pace with the expansion of the mine production. However, the metallurgical stages of the industry have not (yet) been developed in Indonesia and Papua New Guinea and only very recently in the Philippines.

Over the past decades, the developing countries have started to play another role in the world copper industry: a number of them have become significant producers of copper semis. The initiation and expansion of the production of copper and copper alloy semis has been concentrated in the socalled Newly Industrialising Countries (the NIC's). Wire rod (continuously cast) is the single most important product. The share of the developing countries in refined consumption has increased from less than 5 per cent in 1960 to over 12 per cent at present.

A third tendency over the past decades has been the increasing share of the developing countries in the world imports of copper semis. Available data indicate that the share of the developing countries in the imports of the market economies increased from about 10% in 1969 to more than 25% in 1981 [1].

---

1) Source: Yearbook of International Trade Statistics

This substantial increase occurred despite the very rapid increase in imports of refined copper by the developing countries and despite the rapid expansion of world trade in copper semis. Particularly in recent years, the copper semis sector has become more internationalized and the developing countries have become an important market for exporters from the EEC (Western Europe) and Japan.
A fourth important phenomenon of the recent past is rather a non-event: the copper producing developing countries (like Chile, Peru, Zambia and Zaïre) did not become important producers and exporters of copper semis. The expectations and the aspirations of the countries concerned - articulated, for instance, at the Cipec Conferences of the late sixties and early seventies - have not been realized [1]. Chile has traditionally been and remained an exporter of limited amounts of copper semis. Exports from Peru are small (but increasing) and only recently Zambia started to export a very small amount of wire rod. For these and other copper countries, this sector has not (yet ?) become a basis for resource based industrialization.

The present paper is intended as a review of evidence both of the facts and of the explanations of these facts as given in the literature:

- A review of the past trends by analysing statistical time series. Up to and including the refining stage, statistics are complete and detailed. For semi-manufactures, however, the data are limited and incomplete and sometimes they cover only a short time span.
- A critical review of the available literature that tries to explain why things happened as they did happen. For the mining and metallurgical sector the literature is rather extensive, but for semi-fabrication this is not the case.

Apart from serving as a data base on the international copper industry, the objective of this paper is to get an overview of the state of the art in the analysis of factors that determine the location of production of copper semis in (copper producing) developing countries. Such an overview seems particularly useful in identifying the factors

---

1) Gueronik S.R.: "Cipec and Semis", in Metal Bulletin, Special issue on copper, 1974

that have to be investigated more intensively.

The paper follows the four phenomena that have been observed above. As regards the first phenomenon - the traditional role of the copper countries - care will be taken to deal with this subject only to the extent that it is relevant for the fabrication of semis. The structure of the industry and the relations between host governments and multinationals in the copper industry, are relevant for the location of the fabrication of copper. Besides, smelting and refining are froms of processing a raw material. Factors influencing their location in producer countries could therefore be of some relevance for the local processing of semi-manufactures. Subsequently, in the third Chapter, attention will be given to the fabrication of copper semis, starting with the (changing) characteristics of the international semis sector. However, the emphasis here will be on the increase of refined consumption and the consequent rapid growth of the semis sector in a number of developing countries. The fourth Chapter deals with international trade in copper and copper alloy semis. Not only the industrialized countries are important markets. There is also a significant long-distance trade from industrialized countries to developing ones. It seems highly relevant to analyse the magnitude and composition of this trade. Besides, an attempt will be made to describe the (recent) developments in the exports of copper semis from developing countries.
In the final Chapter the threads of the argument are being brought together and some additional points are being added while addressing squarely the question of the still very limited degree of processing of refined copper into semi-manufactures in the raw copper producing developing countries.

CHAPTER I

Mining

Over the past 10 to 15 years the developing countries have increased their share in the world copper mining output, particularly when related to the production of the market economies. This happened in the context of a general slow-down in the expansion of production, and it was accompanied by significant shifts in the geographical distribution of production. The phenomena can be explained by changes in the relations between host countries and foreign companies, changed practices in the financing of mining ventures and - not unrelated to the other two factors - changes in the structure of the international mining sector.

I.1 The geographical distribution of production

The world mine production of copper (in terms of Cu-content) increased from two and a half million tons in 1950 to eight and a quarter million tons in 1983. Over the long run (1950-1980) [1] the average annual growth rate was just over 4 per cent per year. However, the growth rate has declined over time. In the fifties, world production increased at a rate of over 5 per cent per year and in the seventies the growth rate averaged 2.5 per cent per year. Besides, the rate of growth in the Centrally Planned Economies (CPE) has been about double the growth rate in the market economies (Table 1).
Within the group of the market economies [2] there have been important and interesting discrepancies between the growth rates in the developed market economies (DME) and the developing countries (LDC) (Table 2).

---

1) Figures for 1950, 1960, etc., are three year averages for 1949-1951, 1959-1961, etc.
2) Only very little attention is being given to the Centrally Planned Economies, because they are not integrated in the "world market" of the market economies

TABLE 1

Growth rates of world copper mine production (1950-1980) and production in 1983 (x 1,000 tons) 1)

	1950-1960	1960-1970	1970-1980	1983
World	5.2	4.3	2.5	8,255
CPE	9.6	7.1	4.0	2,010
ME	4.5	3.7	2.1	6,245

Source: Statistical Annex, Tables 1.1, 1.2 and 1.3

In the nineteen fifties production in the developing countries expanded very rapidly, at a rate of almost 6 per cent per year, almost double the growth rate realized in the industrialized countries. In the sixties the situation reversed. On average, production increased much faster in the developed market economies than in the developing countries. In the seventies and early eighties, the situation changed drastically, back to the pattern of the fifties and more than that. While in the industrialized countries the production of the copper mines stagnated and in the early eighties even declined, production in the developing countries increased at rates of 3 to 4 per cent per year.

TABLE 2

Growth rates of copper mine production in the market economies (1950-1980) and production in 1983 (x 1,000 tons)

	1950-1960	1960-1970	1970-1980	1983
ME	4.5	3.7	2.1	6,245
DME	3.1	4.3	0.7	2,513
LDC	5.9	2.7	3.6	3,732

As a consequence of the divergent growth rates, the share of the developing countries in the copper mine production of the market economies has been going up, down and markedly up again over the past decades.

1) Throughout this paper, tons means metric tons

Around 1950 the share of the developing countries was at a level of 45 per cent (Table 3), but increasing and passing the fifty per cent mark around 1960. In the sixties, their share dropped to well below 50 per cent again, but in the seventies the situation changed appreciably and in the world economic crisis of the eighties even drastically: in 1983 the share of the developing countries reached the 60 per cent level. The developing countries are, more than ever before, the major producers and suppliers of copper ore in the market economies.

TABLE 3

Percentage shares of developing countries and developed market economies in the mine production of the market economies

	Developing countries	Developed Market Economies
1950	45	55
1960	52	48
1970	47	53
1980	54	46
1983	60	40

The declining share of the developed market economies over the long run, is completely due to the stagnation and recently even the decreasing production in the United States of America. The share of the USA in the production of the market economies dropped from 35 per cent in 1950 to less than 17 per cent in 1983. In the fifties the declining share of the USA could partly be compensated by a rapid growth of production in some other countries, particularly in Australia. In the sixties production increased again fairly rapidly in the USA and very rapidly in South Africa. Consequently the share of the industrialized countries increased. In the seventies and early eighties, neither South Africa nor Australia could compensate for the declining production in the USA.

The increasing share of the developing countries over the long run, is due to a more than average expansion of production in Chile and Peru,

and in Mexico in the seventies, while Indonesia, the Philippines and Papua New Guinea - starting from (almost) zero - became important producers in recent years. The share of Chile and Peru in the production of the market economies increased from almost 18 per cent in 1950 to more than 25 per cent in 1983 and the share of Indonesia, the Philippines and Papua New Guinea reached a level of more than 8 per cent in 1983. However, marked differences in performance during this period can be observed. This holds particularly true for Africa (Zambia, Zaïre) on the one hand and Latin America (Chile, Peru) on the other.

In the nineteen fifties production expanded (relatively) rapidly in Africa, particularly in Zambia. Since then production growth in Zambia has been (far) below average. Consequently the share of developing Africa in mine production has first increased from 21 per cent in 1950 to 26 per cent in 1960 and subsequently decreased to 19 per cent in 1983.

The share of Latin America in the mine production of the market economies oscillated around 20 per cent in the fifties and sixties. In the early seventies, production started to grow very rapidly in Chile (post-Allende period). Consequently the share of Latin America has reached almost 30 per cent in 1983. With an output of one and a quarter million tons, Chile has - with a share of 20 per cent in the production of the market economies - become the largest copper producing country in the world with more production than the USA or the USSR.

I.2 Nationalization, changing structure and accommodation

A precondition for a lasting large share of the developing countries in the world copper production is to have a corresponding share of reserves that can be exploited at competitive costs. The available estimates of exploitable reserves vary according to the definitions used and the long-run price that is being assumed. However, some recent estimates indicate that the share of the developing countries in the reserves of the market economies is in the order of magnitude of

two thirds [1]. Despite the uncertainties involved, it seems therefore clear that even the present high share of the developing countries in mine production (60 per cent) is in line with their share in reserves. Besides, one has to take into account that the territories of the industrialized countries have been explored more intensively than the developing countries.

Exploitable reserves can range from rather marginal ones to ore bodies that can be exploited at low cost. However, information on costs of production is very limited, based on different assumptions and relative cost positions of countries seem to change appreciably over time [2]. It is certain, however, that many of the high cost producers are to be found in the developed countries. Without regard to the costs of production, it is impossible to understand two of the major phenomena in the recent changes in the location of copper mine production: the almost continuously declining share of the USA and the rapidly increasing share of Chile since the early seventies. The USA is a high cost producer. Without protection and/or subsidies, many of the mines cannot compete with imports. Chile is a low cost producer, with presently perhaps (apart from Bougainville ?) the lowest production costs in the world. The ore grades and the geological conditions are major determinants of the costs of production.

The case of Chile, with a declining share in production in the fifties and sixties, indicates, however, that low production costs are - at least in a developing country - not a sufficient condition for a high and increasing share in world production. The country has to be considered a reliable supplier and must have good relations with the major private companies in the industry. In other words: given the

---

1) Deduced from Gluschke, W., J. Shaw and B. Varon: "Copper: the next fifteen years", Reidel, Holland, 1979, p. XXIV and Mikesell, R.: "The World Copper Industry", Johns Hopkins, Baltimore, 1979, p. 12

2) Mikesell, R.: "The World Copper Industry; structure and economic analysis", Johns Hopkins, Baltimore, 1979, p. 122-124; Resources Policy, March 1984, p. 21-22. The exchange rate policy of a country seems very important in this respect, because in cost estimates apparently no adjustments are made for overvalued currencies

reserves and costs of production, the structure of the sector and the relation of the developing country concerned with foreign private mining companies are decisive for the level and rate of growth of production in that country.

Structure of the sector

The structure of the world market for refined copper (the major internationally traded product) has in 1980 been characterized as a "homogeneous oligopoly with a large competitive fringe" [1]. There has not always been such a "large competitive fringe". Until around 1950 the industry was dominated by seven North American and European companies: Kennecott and Anaconda (both active in Chile), Phelps Dodge, the Roan-American Metal Groups and Anglo American in Zambia (Northern Rhodesia), Union Minière in Zaïre (Belgian Congo), and International Nickel of Canada. These companies are, apart from International Nickel, real "copper companies" and together they produce at that time around 70 per cent of the mine production of the market economies [2].
The position of the established oligopolists was - and this started already before the Second World War - being threatened by the discovery of ore bodies in several places in the world and by the "lure of profits similar to the 40% per year realized by Kennecott in Chile"[3]. The oligopolists defended their positions in several ways, one of them being a strategy of low refined copper prices and another one a forward integration into the fabrication stage. The first strategy is most clearly observed in the period 1964-1966 when low producer prices prevail througout the Western World. These low prices were an attempt to counteract tendencies towards backward integration by copper fabrica-

---

1) Labys, W.: "Market Structure, Bargaining Power, and Resource Price Formation", Lexington Books, Lexington, 1980, p. 87
2) Moran, Th.: "Copper in Chile", Princeton University Press, Princeton, 1974, p. 30
3) Moran, op.cit., 1974, p. 29

tors. However, this policy met with heavy resistance from developing copper countries (particularly Chile) and had to be abandoned after a short while [1].

Already in the nineteen twenties Anaconda and Kennecott embarked on a strategy of forward integration. "In the United States, the same pattern was repeated by Phelps Dodge, American Smelting and Refining, and Cerro; in Canada, by Noranda; in Europe by the Union Minière-Société General du Belgique Group; and in Japan most prominently by Sumitomo, Mitsubishi, and Nippon" [2]. In the United States at least, policies of forward integration were not vigorously continued after 1945. This was partly due to the anti-trust policy of the government. Besides, and this factor has more general validity, "the technologies associated with the fabrication and manufacture of copper products became standardized" [3]. The number of more or less independent fabricators increased.

The defensive policies of the traditional oligopolists were not completely successful and the factors working towards a dilution of the copper oligopoly dominated. The five major factors at work in the fifties and sixties have been listed by Moran [4]:

- The, already mentioned, discovery of large new sources of copper in the Americas, Africa, Asia and Australia.
- The stimulation of production by governments of industrialized countries. The USA started such measures in the forties and Japan and West Germany in the fifties. The subsidies served as finance capital for small and new ventures.
- Backward integration by smelters, refiners and fabricators. This applies both to American, European and Japanese companies.
- The willingness of fabricators and consumers of copper to finance the growth of new (small) copper mines and be paid back in copper output. Not only Japanese but also German firms have been very active in financing new mines.

---

1) Producer prices have persisted much longer in the USA, but the deviations from the LME-prices have been more limited
2) Moran, op.cit., 1974, p. 38-39
3) Mardones, J.L.; E. Silva and Ch. Martinez: "The copper and aluminium industries", in Resources Policy, March 1985
4) Moran, op.cit., 1974, p. 32-37

- Horizontal diversification of natural resource companies into copper.

Nationalizations

The four large copper exporting developing countries wholly or partly nationalized the copper industry in their countries. In 1967 Zaïre nationalized the properties of Union Minière du Haute Katanga. In 1969 Chile nationalized the large mines of Anaconda for 51 per cent and announced plans to nationalize Kennecotts' El Teniente mine. In 1971, under President Allende, all large Chilean copper companies were nationalized, including a 70 per cent subsidiary of Cerro Corporation. In 1969 Anglo American and Amax were invited to transfer 51 per cent of the shares of their Zambian subsidiaries to the state. The partial nationalization in Peru was quite complicated. The process was started by the new revolutionary government in 1968. Major events were the state monopolization of all refining and marketing activities in 1971 and the final agreement regarding the take-over of several companies, including Cerro de Pasco from Cerro Corporation in 1974.

The developing copper producing countries had the intention to become the dominant force in the world copper industry. To this end they also established CIPEC (the "Conseil Intergouvernmental des Pays Exportateur de Cuivre") Chile, Peru, Zambia and Zaïre formed CIPEC in 1967 [1]. The objective of the organization was (and is) essentially to co-ordinate the price and production policies of the members. In the early seventies it was obvious that CIPEC could never become as powerful as OPEC, not even temporarily, but the countries themselves had at that time the aspiration of becoming a strong countervailing power vis à vis the private oligopolists.

Already around 1960 it was evident that the Latin American copper countries not only wanted a larger share of the profits resulting

---

1) Later on Indonesia and Papua New Guinea joined CIPEC

from copper exploitation, but that the pressure for indigenous participation in the local subsidiaries of the copper multinationals was likely to increase. By the time of independence of the African copper countries, the threat of nationalization (not only in Africa but also in Latin America) became obvious to all the Western companies. With the expectation of a continued rapid increase in world copper demand as an additional impetus, these companies started a massive search for diversification of the sources of supply. Both the fabricators and governments of consumer countries (among them the Federal Republic of Germany, France and Japan) became more interested in "secure" sources of supply. On the one hand they turned to the mineral-rich industrialized countries and on the other hand to developing countries that were considered less of a political risk. As a result of this diversification strategy the share of the developed countries in the production of the market economies increased substantially in the sixties. Production expanded very rapidly in South Africa with an annual average growth rate over the decade of almost 11 per cent. Above average growth rates were also recorded in the USA, in Canada and in Australia. Outside the traditional copper exporting developing countries, production and exports expanded very rapidly in the Philippines. Due to time lags between initiation of a project and actual production, Indonesia and Papua New Guinea became only important producers in the seventies. For the nineteen sixties it is striking that the decline in the share of the developing countries was completely concentrated in the four original members of CIPEC: Chile, Peru, Zambia and Zaïre; their share declined from 44 per cent in 1960 to 39 per cent in 1970. Besides, the share of Peru, the country that followed the most modest course in nationalization, did not decline. The nationalization measures taken by Chile, Zambia and Zaïre and the subsequent reaction from the Western oligopolists are evidently the major explanation for the relative stagnation of production in these countries in the sixties.

Referring to attempts to use the "monopoly power" of CIPEC, Moran expected that the new 'independents' - when continuing their policies of around 1970 - would make themselves to suppliers of last resort. The major reason being given is that "there has been a trend for major consumers to try to cover the bulk of their needs from the semi-integrated system of corporate producers as fast as the companies can expand output, while treating the CIPEC production more and more like a spill-over market. In this way, by the end of the decade the CIPEC share could be less than 30% of world production" [1].

Accommodation

Actual developments were contrary to this pessimistic outlook: the share of the developing countries in the production of the market economies increased from 47 per cent in 1970 to 60 per cent in 1983. To avoid any misunderstanding, the actual developments were certainly not excluded by Moran. More than 12 years ago he formulated the precondition for this to happen: "It requires, in effect, joining the oligopoly and playing according to its rules" [2]. This is essentially what happened and what explains the more thans average production growth in the developing countries over the past 10 to 15 years.

In the nineteen seventies the private oligopolists regained a position of strength vis á vis the governments and state companies of the developing countries. The structure of the sector continued to change. Mineral projects are - starting around 1965 - being financed in different ways. There has been a tendency towards de-nationalization. The governments of developing countries have been accommodating the private oligopolists. However, when reviewing these phenomena, it must be kept in mind that the copper market has been depressed since 1974. Low prices and stagnating demand have considerably weaken-

---

1) Moran, op.cit., 1974, p. 239
2) Moran, op.cit., 1974, p. 242

ed the economic and financial position of the exporting countries, particularly those heavily dependent on copper, like Zaïre and Zambia. Because of stagnating consumption, many copper mining projects have been shelved or postponed. In 1973-1975 this was the case with 25 projects. "This backlog of potential new sites obviously weakens the position of any single developing country trying to attract foreign investment on favourable terms" [1].

The major factors explaining the strengthened position of the private oligopolists, appear to be:

1) Horizontal diversification, resulting in widely diversified natural resources companies. Particularly after 1974 (higher oil prices) large oil companies have been taking over hard-minerals companies. For instance: Atlantic Richfield buys Anaconda and Sohio takes over Kennecott, while Socal acquires a 20 per cent share in Amax. This tendency was strongest in the USA: seven of the ten major copper producing companies were acquired by oil-related companies [2]. These mergers and take-overs have greatly strengthened the financial positions of the liquidity-starved hard-minerals companies.

2) Mutual linkages between the private oligopolists of the copper sector have strengthened their individual and collective positions in the world market. It is not unusual that companies hold small amounts of each others' shares [3]. Asarco, for example, owns or has owned a share, varying between 5 and 10% of the outstanding shares in Anaconda, Kennecott and Cerro. Phelps Dodge, to give another example, owns 3.5 per cent of the Amax shares [4]. Besides, interlocking directorates seem to occur rather frequently in the copper industry [5]. In this way the companies are at least better informed regarding the actions of their competitors. It also happens quite often that companies supply loan capital to each other.

---

1) United Nations, Centre on transnational corporations: "Transnational corporations in the copper industry", New York, 1981, p. 62
2) Resources Policy, March 1984, p. 26
3) Becker, D.: "The new bourgeoisie and the limits of dependency", Princeton University Press, Princeton, New Jersey, 1983, p. 76
4) Mezger, D.: "Copper in the world economy", Heinemann, London, 1980, p. 175
5) Becker, op.cit., 1983, p. 77; Mikdashi, Z.: "The international politics of natural resources", Cornell University Press, Ithaca, 1976, p. 94

Finally, through sales agency agreements companies can assure themselves of market outlets through other oligopolists in the business: Asarco markets part of the production of Duval and the share of Newmont in the production of Southern Peru is being sold by Amax [1]; Anglo American sells a certain amount of copper that has been refined by Amax [2].

3) New mining ventures, both inside and outside developing countries, have increasingly been undertaken as joint ventures of two or more private corporations. Joint ventures are an excellent device to spread financial risks, which have increased with the scale of mining operations. In most cases, one large integrated mining company takes the lead in a joint venture/consortium. But smaller mining companies, custom refiners and fabricators also participate in such ventures. Besides, refiners and fabricators also "participate" in such projects through long-term sales contracts[3]. The phenomenon of joint ventures/consortia means that groups are being formed of central oligopolists and firms from the "competitive fringe". Together in one project, they form a powerful entity with respect to technical and managerial know how, finance, processing and marketing.

4) The formation of joint ventures/consortia of producers has been stimulated by changes, since about 1965, in the financing of mining projects. There has been a shift from equity financing to debt financing and from company financing to project financing [4]. Large mineral projects are nowadays usually being financed by a consortium of banks. In the financing package are normally also included suppliers credits and customers credits, the latter linked to long-term contracts. The financing consortium can have much influence on a mining project [5]. Two conditions usually being stipulated are: long-term sales contracts for the bulk of production and the participation in the project of an experienced international mining company [6]. Particularly the latter condition can enhance greatly the position of the companies qualifying as such.

---

1) Becker, op.cit., 1983, p. 77
2) Mezger, op.cit., 1980, p. 174
3) Becker, op.cit., 1983, p. 77; see also United Nations, op.cit., 1981, p. 47, and Mezger, op.cit., 1980, p. 173-181
4) United Nations, op.cit., 1981, p. 38 and 47-49; Radetzki, M.: "Has political risk scared mineral investment away from the deposits in developing countries ?", in World Development, Vol.10, No. 1, 1982, p. 46
5) See e.g. Mezger, op.cit., 1980, p. 120-142
6) Mikesell, op.cit., 1979, p. 254-255

With the strengthening of the position of the private oligopolists, the position of the developing countries with regard to national control over their copper industry has weakened in a situation of a continously depressed copper market since 1974. In the developing countries, there has been a tendency towards de-nationalization. In the "new" copper countries - mainly Indonesia, the Philippines and Papua New Guinea - the national interest in the mining ventures (through private investors or state enterprises) - is typically at a level of between twenty and sixty per cent of equity. In the "old" copper countries, new projects have been started by foreign companies in Chile, Peru and Zaïre [1]. In Chile the foreign investment law of 1975 permitted 100 per cent foreign ownership of new mines; Exxon acquired the Disputada Mine and Anaconda the Los Palambres. In Peru the consortium Southern Peru (Asarco, Phelps Dodge, Newmont, Cerro and Billiton) has developed the Cuajone mine and is by far the largest producer in the country. "Thus, the industry has evolved from foreign ownership through partial or complete nationalization to one of shared control" [2].

Starting from the weakness(es) of the developing countries, a major reason given in the literature for the accommodation ("shared control") of the private oligopolists is that the state enterprises of the developing countries are not able to expand capacity (develop new mines) without foreign participation [3]. May be this argument holds true for most developing countries, but it does not seem to have general validity for the Latin American countries. One of the major theses of Becker is that Minero Peru has the technical competence to develop new mines [4]. Besides, state companies in Brazil and Mexico have successfully developed new large scale mines without any foreign equity participation [5].

---

1) May be it is even more illustrating that in all plans for major new ventures (most of which have been shelved) the private oligopolists were heavily involved, not only as project managers, but also with equity participation
2) Labys, op.cit., 1980, p. 97
3) For instance by Labys, op.cit., 1980, p. 98
4) Becker, op.cit., 1983
5) Radetzki, op.cit., 1982, p. 43

A more general factor weakening the position of developing countries and their state companies over the past 10 to 12 years, has been the depressed copper market, causing losses (or very low returns) for the state companies and declining or stagnation export proceeds. "Developing country governments have probably arrived at a more sober assessment of the benefits which nationalization of mineral assets can bring: it does not bring them, for example, an automatic flow of profits to finance re-investment" [1]. Full ownership can bring in handsome profits at times of a thriving copper market, but in a depression the state also has to suffer all the losses. Major expansions of existing mines, let alone the development of new ones, could not be financed by the state companies nor by the treasuries of the developing countries concerned.

The most general reason for the failure of the nationalization-cum-CIPEC strategy of the sixties and early seventies, is that the state companies had to become "good" oligopolists. A relaxation of prevailing financial constraints in the years to come would not change this basic pre-requisite. In the prevailing structure of the world copper industry there is no place for state oligopolists that would like to go it alone [2]. All the major private oligopolists, be they very old ones like Kennecott or rather new ones like the Japanese consortium of Dowa etc. co-operate quite frequently with each other, but most intensively with the "competitive fringe" of the copper industry. The oligopolistic structure of the industry is such that the interests of all the participants can be taken care of and that they are respected by the other parties. Mines need assured outlets for the excess production they cannot refine themselves. Custom refiners need assured supplies of blister. Fabricators need assured supplies of refined copper. All of them are - inter alia for reasons of competition with

---

1) Toye, J.: "The recession, the third world and base metal industries", in World Development, Vol. 12, No. 9, 1984, p. 931

2) See Table 1 of the General Annex listing the major companies engaged in copper mining

(potential) substitutes - opposed to the "exploitation" of scarcity situations by means of monopoly-prices.

The practices and customs in the industry have evolved in such a way that there are mechanisms permitting each participant to safeguard his interests. These are the mechanisms of co-operation in projects, co-ordination of action and long-term agreements that have briefly been described above. The ologopolists are and remain competitors, but they all appreciate the value of the mechanisms to avoid ruinous competition.

The state companies of the developing countries enjoy the advantage of easy access to the ore bodies. Therefore they do have the potential of becoming central, integrated oligopolists. In order to achieve this, they will have to build up the reputation of reliable oligopolists. Reliable suppliers, not exploiting scarcities to the limit and giving private oligopolists the chance to safeguard their interests. This implies also that they will have to co-operate with them in contractual market arrangements and in projects. In this way the state companies could become healthy and strong oligopolists and in this sense they would become more independent. However, it would also mean that they hardly could be distinguished from the private oligopolists because they have to act in the same way. In this sense they could be considered less independent.

CHAPTER II

Smelting and refining

Smelting and refining are usually the first stages in processing copper concentrates [1]. Together they form the metallurgical stage of the copper industry. Over the long run, a somewhat greater share of mine production of most developing countries goes through the metallurgical stage before being exported. As regards the factors influencing the location of smelting and refining, a distinction is being made between technical factors and institutional factors. The technical factors are those inherent in the characteristics of the products, like production costs, value added, specifications, etc.. The institutional factors are those amenable to human action, like trade protection and the structure of the market.

II.1 Geographical distribution and resulting trade patterns

Geographical distribution

Already around 1950 almost ninety per cent of the copper ore mined in the developing countries was being smelted locally. This percentage has remained about constant for a large number of years (Table 4). In the nineteen seventies, however, the part of the copper ore that is being smelted in the developing countries of origin, declined and reached a level of 77 per cent in 1979/81. At the same time, the copper smelter production of the industrial countries reached a level of about 120 per cent of their mine production around 1980 [2].
The recent decline of smelter production in the developing countries relative to their mine production is completely due to the fact that in the seventies Indonesia, the Philippines and Papua New Guinea be-

---

1) Only oxyde ores, presently about 5 per cent of total production, are being leached and not smelted
2) The figures relate to primary smelting only; total smelter production in the industrialized countries is about 10% higher, because of secundary smelting of scrap

TABLE 4

Smelter production as percentage of mine production in developing countries (LDC), developed market economies (DME) and market economies (ME)

	1949/51	1959/61	1969/71	1979/81
LDC	89	89	86	77
DME	110	110	111	119
ME	100	99	99	97

Source: Tables 1.1 and 2.1 of the Statistical Annex

came important ore producers, while around 1980 still no smelting (nor refining) is taking place in these countries [1]. Excluding these countries, 91 per cent of the mine production is being smelted in the other producing countries in 1979/81.

As regards the industrialized countries, the two most important facts are a stagnation and subsequently a decline of smelting in North America and a spectacular increase in Japan. In North America (Canada plus USA) over 100% of the mine production was still being smelted in 1959/61 and in 1979/81 this percentage had declined to just over 80%, mainly because of exports of concentrates from (Western) Canada. In Japan, with a negligible mine production, primary smelting increased very rapidly in the sixties and, despite a more modest growth in the seventies, approached a level of one million tons in the early eighties [2].

Over the long run, the production of refined copper has been growing more rapidly in the developing countries than their mine production of copper ore. In the period 1949/51 to 1979/81, the production of ore increased at an average annual rate of 4.1% and the production

---

1) In 1983 both smelting and refining was started in the Philippenes; provisional figures indicate that production reached a level of 100,000 tons in 1984

2) For details see Table 2.3 of the Statistical Annex

of refined at a rate of 4.9% [1]. Consequently, refined production as a percentage of ore production increased from 52% in 1950 to 60% in 1980. However, first refined production declined slighty relative to mine production in the nineteen fifties. In the sixties refined production as a percentage of mine production increased vigorously, from almost 50% in 1960 to almost 60% in 1970. In the seventies the last mentioned percentage remained about constant (Table 5).
This simple picture is, however, complicated by two factors: secondary refining and primary refining in non-ore producing developing countries and secondly by the fact that the "new" copper countries - Indonesia, the Philippines and Papua New Guinea - do not (yet) have any refining capacity around 1980.

TABLE 5

Production of refined copper in developing countries as percentage of mine production

	Refined prod. as percentage of mine prod. (1)	Idem (1) adjusted for secondary and non-ore prod.counts. (2)	Idem (2) adjusted for Indonesia,the Philippines and Papua New G. (3)
1949/51	52	52	52
1959/61	49	49	49
1969/71	59	58	62
1979/81	60	55	65

Source: Statistical Annex

In the nineteen seventies primary refining gained some importance in South Korea and Taiwan (over 100,000 tons around 1980) while secondary refining (from scrap) was started in Brazil and Mexico. Taking these factors into account, refined production as a percentage of

---

1) Statistical Annex, Tables 1.3 and 3.3

mine production declined from 58% to 55% in the seventies (Table 5). In the traditional copper countries, however, the level of refining increased in the seventies, but the increase was much more limited than in the sixties.

As with smelting, the situation in the industrial countries is the in reverse picture of the one in the developing countries. Around 1980 the production of primary refined copper is at a level of 140% of the mine production.

In Europe there is a wide discrepancy between mine production and primary refined production. In 1979/81 primary refined production (almost 950,000 tons) was more than three times as high as mine production. Belgium and The Federal Republic of Germany are the most important producers (together 60% of the total).

In North America the production of primary refined copper increased at a very modest rate in the nineteen sixties and stagnated completely during the seventies. In the early eighties the production declined by almost 400,000 tons. In 1979/81 primary refined production was at a level of only 90 per cent of mine production, while it was still equal to mine production in 1969/71. This development is largely due to declining primary refining in Canada.

Like in the case of smelting, Japan has been the decisive factor in the developments of the last decades. In 1959/61 primary refined production from imports was less than 100,000 tons. In 1969/71 this figure had increased to 450,000 tons and in 1979/81 to almost 850,000 tons. The relative stagnation of refining in the developing countries in the seventies is for a large part due to the continued rapid increase of primary refining in Japan [1].

Trade patterns

From the readily available statistics it is not possible to draw up a complete and consistent picture of the international trade flows

---

1) Also in South Africa refined production increased rapidly in the seventies (7.5% per year or 80,000 tons over the decade)

that matches the picture of the international allocation of copper production. There is a problem of more or less significant discrepancies between imports and exports of the market economies within the same categories of products [1]. Looking at the situation around 1980 (1979/81) the divergence between total exports and imports is limited to 5 per cent (Table 6). For "blister and anode copper", however, the discrepancy is significant.

TABLE 6

Exports and imports of the market economies in 1979/81 (x 1,000 metric tons)

	Exports	Imports
Ores and concentrates	1,322.0	1,228.0
Blister and anode copper	748.4	559.2
Refined copper	2,778.3	2,816.6
	4,848.7	4,603.8

Source: Statistical Annex, Tables 5, 6 and 7; figures for ores and concentrates are in Cu-content

The major shortcoming of the statistics is most probably that too small a number of countries are being covered in the statistics. The export side seems generally more complete than the import side and this is particularly true for "ores and concentrates" and "blister and anode copper". In these cases, almost all exports are being covered when one adds up the list of "copper countries". With a very short list of importing countries, one probably overlooks part of

---

1) For the centrally planned economies data are available on East/West trade in refined copper; since these imports and exports are not far apart, exclusion of these trade flows redresses the divergence only to a limited extent

the imports [1]. Because of these and possible other shortcomings, the statistics should be interpreted with care. Nevertheless, they are considered good enough to provide a general understanding of the global picture.

Of the total exports of more than 4.8 million tons, 65 per cent originates in the developing countries and only 35 per cent in the industrialized countries.

The international orientation of the copper industry is once more demonstrated by the fact that the total exports of 4.8 million tons are equivalent to 78% of the mine production of the market economies or to 68% of their refined production (including secondary refined). However, the copper sector is much more outward oriented in the developing countries than in the industrialized countries. In 1979/81 the total exports of the developing countries are equal to 94 per cent of their mine production, while in the industrial countries the exports are only equivalent to one third of their refined production [2].

Another difference between developed and developing countries is the composition of their exports (Table 7). For both groups of countries the exports of concentrates are relatively at about the same level; in both cases these exports are just under 30 per cent of total copper exports. The major difference is to be found in the categories of blister on the one hand and refined copper on the other. The exports of blister of the developed countries are almost negligible (5% of the total) and consequently 65 per cent of the exports consists of refined copper. For the developing countries more than 20 per cent of total exports consists of blister and only just over 50 per cent is exported in the form of refined copper.

In the absence of matrices for trade in copper, the best we can do to

---

1) Inclusion of the imports of the centrally planned economies from the market economies, could of course also help to close the gap; this could particularly be the case with respect to concentrates and blister

2) In both cases we relate the exports to the stage with the highest output

TABLE 7

Exports and imports of copper of the developing countries and the developed countries; averages for 1979/81 (x 1,000 tons)

Developing countries	Exports	Imports	Net (minus=export)
Ores and concentrates	822.7	105.9	- 716.8
Blister and anode cop.	622.4	-	- 622.4
Refined copper	1,683.9	309.2	- 1,374.7
TOTAL	3,169.0	415.1	- 2,753,9 1)
Developed market Economies	**Exports**	**Imports**	**Net (minus=export)**
Ores and concentrates	499.3	1,122.1	+ 622.8
Blister and anode cop.	86.0	559.2	+ 473.2
Refined copper	1,094.4	2,507.4	+ 1,413.0
TOTAL	1,679.7	4,188.7	+ 2,509.0

Source: Statistical Annex

get a global picture of international trade is to calculate the net exports and net imports of respectively the developing countries as a group and the developed economies as a group (Table 7). In doing this, it is tempting to think in terms of exports as going to the other group and imports coming from the other group. In reality this is of course not the case;exports of one developing country can be imports of another developing country. However, for the net position of a group it does not matter whichever way one looks at the statistics; net exports go out of the group of countries and net imports come into the group.

Table 7 indicates that the developing countries as a group export roughly 2.5 million tons of copper per year and that the industrial countries import about the same amount. A comparison between the net

---

1) Around 1980 China imported on average almost 100,000 tons of refined copper per year

exports of the developing countries and their mine production indicates that these countries around 1980 had reached a consumption level of primary refined copper of about 750,000 tons [1].

II.2 The factors influencing the location of smelting and refining

Two phenomena are to be explained. The first one is the fact that in the nineteen sixties primary refining as a percentage of mine production reached a higher level in the developing countries (roughly from 50% to 60%) but that this increase stagnated in the seventies. The second and major issue is the fact that in the developing countries copper smelting has for many years been at a much higher level than copper refining; already around 1950 about 90 per cent of the mine production was being smelted locally and only 50 per cent being refined.

The rapid increase of refining in the sixties and the subsequent stagnation in the seventies is likely to be explained by differences over time in the growth rates of mine production and changes in the relations between developing countries and foreign investors. In the nineteen sixties mine production in the developing countries increased very slowly when compared with the growth rates realized in the fifities (respectively 2.7 and 5.9 per cent per year on average). Refined production, with long gestation periods to expand output, could "catch up" with mine production. The expansion of refining capacity in the sixties is moreover likely to be related to deliberate policies of developing countries aiming at higher levels of local processing and this policy could partly succeed due to rather good host country/investor relationships in the fifties and early sixties, particularly relevant in the case of Chile [2]. In the seventies, however, there was a general decline in the growth rate of mine production, but the growth rate in the developing countries accelerated. Re-

---

1) In Chapter III we return to the subject of copper consumption
2) For the African countries, colonial rule and the transition to political independence was most relevant

fining in the developing countries could on average only just keep pace with mining, likely due to limited capacity expansion related to the generally strained relations with foreign companies in the sixties and early seventies. Besides, with very low growth rates in the developed countries, the industry started to suffer from overcapacity. In this situation there was of course hardly any room for expansion of capacity in the developing countries.
The discrepancy in developing countries between the levels of smelting and refining deserves - as this is the most striking phenomenon - a more detailed analysis. Why is there such a substantial difference between local production of blister copper and refined copper ? In analysing this question we look for the similarities and differences between the two products. Besides, a distinction is made between technical factors and institutional ones. The relevant technical factors are the character of the products and the production technologies, the transport costs and the environmental impact of production. The relevant institutional factors are: trade barriers and the structure of the industry.

The technical factors

The economic characteristics of both the product and the production technology - henceforth being referred to as the technical factors - are rather similar for blister and refined copper. Both blister (98-99.5 per cent purity) and refined copper (99.9 per cent purity) are homogeneous products. For refined copper there are different brands with differences in quality. However, there is a "high degree of substitutability among refined copper in many uses" [1].
The metallurgical processes to fabricate blister and refined copper are mainly based on freely available standardized technologies. Both in smelting and refining significant economies of scale can be realized. A smelter must have a minimum annual capacity of 40,000

---

1) Mikesell, op.cit., 1979, p. 79

tons and a refinery of 60,000 tons. A larger scale of production could reduce production costs even further. Nowadays economies of scale seem to taper off at a capacity level of 100,000 tons per year, both for a smelter and a refinery [1]. This means that it would not be warranted to attach a smelter or refinery to a small mine [2]. Economies of scale therefore make smelting/refining prohibitive or questionable in some developing countries. This is, for instance, the case in Indonesia with a present mine output level of 75,000 tons per year.

Both smelting and refining are capital and energy intensive processes with a relatively low value added per ton output. Estimates of some basic data on production costs are given in Table 8.

Value added per ton is somewhat higher in smelting than in refining. With a refined copper price of $ 1,600 per ton, the value added in smelting is about 20 per cent and in refining (taking blister as the base) about 15 per cent. With a higher international copper price, the relative value added is lower and vice versa [3].

Investments per ton of annual capacity are about three times as high for smelting as for refining. In case capital intensive production is considered less suitable for developing countries, refining is, opposite to the actual situation, a better candidate for location in a developing country than smelting.

Energy (included in "other costs" in Table 8) is a very important input in both smelting and refining, constituting roughly about 25% of the total production costs [4]. It is therefore commonly acknowledged that the availability of cheap energy is an important locational factor.

---

1) Takeuchi, K. and Ch. Ching: "Export-oriented processing of primary commodities in developing countries", World Bank, September 1979 (Mimeo), p. 105

2) Assuming, of course, that it is too expensive to derive additional raw materials from other (foreign) mines

3) Both Zorn, op.cit., 1985, and Roemer, M.: "Resource-based industrialization in the developing countries", in The Journal of Development Economics, 6, 1979, set the raw material costs (of concentrates) at 60 per cent of the value of refined copper

4) Zorn, op.cit., 1985, p. 64

TABLE 8

Data on production costs of smelting and refining of copper

	Smelting	Refining
Value added per ton *)	$ 250	$ 200
Investment per ton of annual capacity **)	$ 1,500-2,000	$ 400-600
Capital costs in value added ***)	60 %	35 - 40 %
Labour costs in value added	20 %	25 - 30 %
Other costs in value added	20 %	35 - 40 %

*) UNCTAD: "Processing and marketing of copper: areas for international co-operation", New York, 1982, p. 56
**) UNCTAD, idem, p. 40
***) Calculated from Zorn, S.: "Mining and mineral processing in developing countries", UNIDO, 1985 (Mimeo), p. 70

Labour costs in smelting and refining are also in the order of magnitude of 25 per cent of total costs (apparently based on production in a developed country). They are about as important as the energy costs. However, nowhere in the literature it is mentioned that this factor could possibly - with high labour efficiency - constitute an advantage for location in a developing country.

So far no significant differences in the technical factors were identified between smelting and refining of copper. This is not the case for the transportation costs. Through the smelting process 3 to 4 tons of concentrates are reduced to 1 ton of blister copper [1], while the weight reduction in refining is negligible. The resulting cost saving because of smelting depends of course on the freight rates for the different products and the distance. Radetzki estimated

---

1) Concentrates typically have a Cu-content of 30 per cent

these savings prior to the increase in oil prices of 1973-74 [1]. Based on a reduction in weight of three to one, shipping costs of $ 5 per ton and smelting costs of $ 220 per ton, he calculates a cost saving of 4.5% of the smelting costs. Zorn works with a weight reduction of 4 to 1 (a high ratio), shipping costs of $ 12 per ton and (also very high) smelting costs of $ 440 per ton, resulting in a cost saving relative to smelting costs of 8.2 per cent. "One should note, however, that this latter saving may not be realized in practice, because of a differential in freight rates which sets lower chargers for bulk materials like bauxite, alumina and copper concentrate, as compared to metal shapes. There may also be a possibility that shipping services will be available only from a limited number of suppliers, especially in the case of cargo liner services for handling smelted or refined metal, and that shippers may use their monopoly or oligopoly position to capture some of the transport savings achieved through processing" [2]. On the basis of these estimates and considerations it may be concluded that savings on shipping costs are probably in the order of magnitude of about 7 per cent. This cost saving may constitute an inducement for smelting of concentrates within the copper mining developing countries, but its significance should not be exaggerated [3].

There is a second technical difference between smelting and refining. Smelting is a burden for the environment and refining is not. The major problem in smelting is air pollution resulting from the emission of SO_2 gases [4]. Could this problem explain the "dumping" of copper smelting to the developing countries ? The answer is ne-

---

1) Radetzki, M.: "Where should developing countries' minerals be processed ? The country view versus the multinational company view", in World Development, Vol. 5, 1977, No. 4, p. 327
2) Zorn, op.cit., 1985, 61/62
3) The situation is different when concentrates would have to be transported over long distances to sea ports like in Zambia and Zaïre. In that case smelting at the mine-site is about imperative
4) Mikesell, op.cit., 1979, p. 67

gative. First of all, 90 per cent of the mine production of developing counties was already smelted locally in 1950, at a time when there was hardly any awareness of environmental problems. Besides, both in Europe and Japan normally more than 90% of the SO_2 gas is recovered and converted into sulfuric acid that is sold in local markets [1]. May be environmental considerations contribute presently in preventing the set-up of new production installations. In Europe smelting of ores has about remained constant over the past ten years; in Japan the expansion has slowed down, particularly since 1977.

Summarizing the technical factors, the first general observation is that the similarities between the economic characteristics of smelting and refining dominante the differences. The wellknown difference pertains to the saving on transport costs due to smelting of copper concentrates. These savings turn out to be of limited significance. On the other hand, refining is somewhat more labour intensive than smelting. Also in this case, the inducement to locate refining in a developing country because of low wages could only be of limited significance [2].

The institutional factors

Turning to the institutional factors, the subject of trade barriers is being dealt with first. In the industrialized countries the tariffs on concentrates, blister and refined copper are, as might be expected, generally low and non-tariff barriers are, officially at

---

1) In the USA SO_2 is a greater problem for the smelters, because of the availability of low-cost Frasch-sulfur and higher transport costs; Mikesell, op.cit., 1979, p. 67/68

2) However, with a share of labour costs in value added of 30%, wages at a level of one third of a developed country and labour efficiency at a level of 50%, the saving on total production costs would be 10%

least, non-existent. In the EEC the tariffs are zero [1]. In the USA a specific duty still exists of 0.8 US $ cents per pound both for concentrates, blister and refined. The tariff will be removed by 1987 as part of the Tokyo Round liberalization. In the past, however, it possibly had an impact on the composition of the developing countries' exports, despite a general exemption in the framework of the Generalized System of Preferences (GSP). The reason is that the duties have been applicable to imports from Chile and Peru, because these countries passed the ceilings that are part of the GSP-system of the USA [2]. In Japan the tariff on concentrates is zero, on blister 8.5% and on refined copper 5.6 per cent [3]. This means effective tariffs of about 50 per cent on blister and of 20-25 per cent on refined copper (going from concentrates to refined). Also in Japan the tariffs are in principle suspended for imports from developing countries. However, in Japan duty free ceilings are extremely low. In this way the exemption under the GSP is meaningless [4].

In the industrialized countries non-tariff barriers like quota, etc. do not exist for concentrate, blister or refined copper. However, the less tangible barrier of stimulating smelting and refining in Japan (and to a smaller degree in West Germany) could be regarded as such. Particularly in the fifties and sixties Japan stimulated an engagement of its industry in overseas mining ventures that resulted in the shipment of concentrates to the country. With increasing energy and transport costs (coming on top of environmental considerations) it was expected that Japan would probably change this

---

1) Information on tariffs is derived from UNCTAD, op.cit., 1982
2) Kirthisingha, P.: "Viability of processing in copper-mining areas", in Resources Policy, December 1982, p. 298/299
3) As a result of the Tokyo Round, these tariffs will be reduced to 7.3 and 4.9 per cent respectively
4) In 1982, for instance, the ceiling for each individual developing country was set at 4,371 tons only for blister and refined copper

policy and that at least the metallurgical stages would be left to the mining countries [1]. May be this is going to happen in the future. Presently, however, Japan seems to continue the protection of its copper smelting and refining industry, as is indicated by the very limited tariff reductions in the Tokyo Round.
The incidence of protection of the metallurgical industries in developing countries, is many times overlooked. However, "the domestic market is usually protected from foreign competition by tough quotas and/or high tariffs. (Examples include Brazil, South Korea and Taiwan)" [2]. Brazil protects its copper industry very heavily. Imports are only allowed when Caraiba Metais (a high cost integrated operation with a refining capacity that is 2.5 times its mining capacity) is unable to meet the demand [3]. This is just one example. A systematic overview is not available. However, the extent and degree of protection in the copper importing developing countries warrants more intensive investigation, particularly because these countries are becoming more important copper consumers.
The main conclusion with regard to trade barriers is that there is no significant difference between blister and refined copper. Consequently, trade policies of the importing countries do not explain the different levels of smelting and refining in the mineral-exporting developing countries.

Turning next to the institutional factor of the market structure, it should be noted first that mining companies are generally reluctant to process minerals locally in developing countries. Apart from pure cost considerations, the factor always mentioned is the one of political risk [4]. Another advantage of location of processing in consuming countries, but one that is mentioned less often, is greater

---

1) See, for example, Prain, R.: "Copper, the anatomy of an industry", Mining Journal Books, London, 1975, p. 77
2) Toye, op.cit., 1984, p. 932
3) Copper Studies, March 1984, p. 9
4) See, for instance, Radetzki in World Development, 1977, p. 329

flexibility due to the possibilities of world wide sourcing [1]. However, these factors pertain equally to smelting and refining and therefore do not contribute to an explanation of different levels of smelting and refining in ore producing developing countries.
The most important technical difference related to the location of smelting and refining is, as we have seen, the saving on transport costs that is realized in the case of smelting but not in the case of refining. For Japan this difference has clearly not been important in the past. For Europe and the USA, however, it was apparently of importance [2]. Concentrating on these countries, the problem at hand must be rephrased as follows. Developing countries would like to increase the level of local processing in order to maximize local value added. From the point of view of costs of production, there is no particular cost advantage of locating refining close to the mine in developing countries, but also no particular cost disadvantage. This being the situation, why are the multinationals involved rather reluctant to locate refining in the producer developing countries ? Could they, or a number of them, safeguard their interests in a situation in which a large part of smelting and a smaller part of refining takes place in the ore producing developing countries ?
An already quite sophisticated answer to these questions is being given by Becker [3]. He first states that "no economic incentives that Third World countries can provide will suffice to encourage transnational investment in local refining".
Three reasons are being given to explain this state of affairs:

- location at the mine sites is not more efficient than location close to the major markets;
- much of the refining capacity in the industrial countries is fully depreciated already; there is no need for further amortization;

---

1) UNIDO: "Transnational corporations and the processing of raw materials: impact on developing countries", ID/B/209, 1978,p.13
2) In the USA imports of blister have declined in recent times
3) Becker, op.cit., 1983, p. 88

- the mining companies do not wish to threaten the custom refiners with new competition, because they need them to finance new mines.

We do not consider this a completely satisfactory answer. The second argument is of a "temporary" nature [1]. The third argument has only become valid rather recently. However, it gives an indication that in particular the interests of the custom refiners are at stake.
The nine largest custom refiners account for about 25 per cent of the refinery capacity of the market economies [2]. A major characteristic of these custom refiners is that they are integrated with fabrication (production of semis and cables) [3]. Only a part of the output of the large custom refiners is sold outside the own group of companies.
It seems logical that the custom refiners are very reluctant to relocate their activities (partly) to ore producing developing countries. When relocating activities to a developing country, a custom refiner ceases to be a custom refiner. The refinery would be attached to the mine (major mining company) in the developing country. The custom refiner would lose all the flexibility of world wide sourcing. In this connection it must be kept in mind that traditionally blister produced in developing countries could only be sold to large refineries in five countries [4]. The custom refiners have always been in a strong position in the blister market.
The integration of a custom refiner seems the more important when the refinery originated from backward integration. In these cases a major reason for integration was security of supply [5]. For many

---

1) However, in this case "temporary" can mean: several decades
2) See Table II of the General Annex; a custom refiner is defined as a company refining blister (or concentrates) from others
3) Becker, op.cit., 1983, p. 74; Radetzki, M.: "Market structure and bargaining power; a study of three international mineral markets", in Resources Policy, June 1978, p. 118
4) Radetzki, op.cit., 1978, p. 118; recently this situation has changed slightly due to refining in developing countries like Brazil
5) When integration started primarily from refining, the resulting situation becomes the same when later on fabrication becomes important within the group of companies

years already, these supplies have been secured by long-term contracts. Besides, the custom refiners/fabricators could (and can) manage to get discounts on the LME-price, thus securing advantages over fabricators that are integrated with refining [1].

It seems justified to conclude that it would be disadvantageous for the integrated custom refiners/fabricators to relocate refining to the ore producing developing countries. The supply of blister has so far been secured by long-term contracts and participation in mining/smelting ventures. There has been no necessity to forego the cost saving resulting from local smelting.

Could this situation change in the future ? Is Japan willing to give up smelting and refining of copper ? Are the custom refiners/fabricators in the USA and Western Europe, once their existing installations become obsolete, going to rely more heavily on refined copper coming from the developing countries ? In general: are the industrialized countries going to cede to the developing countries this industry with standardized technology ?

For Japan it is a national decision to reduce the capacity of this polluting and energy-intensive industry [2]. The custom refiners in the USA and Western Europe would need economic incentives to relocate (part of) their refinery production. Above all, however, the developing countries would have to be considered as very reliable suppliers and the Western companies would have to be given the opportunity to become involved in refining in the developing countries in order to be able to safeguard their interests. In this way the outcome could be as expected by Toye: "The base metals industries are following textiles through the 'product cycle' " [3].

---

1) Becker, op.cit., 1983, p. 118-119
2) On the "Japanese contradiction" see Becker, op.cit., 1983, p. 79-81
3) Toye, op.cit., 1984, p. 934

CHAPTER III

The fabrication of copper semis in the industrialized countries and in the developing countries

In the fabricating industry unwrought metal is being transformed into wrought copper products. The fabricating sector is internationally recognized as a separate sector between refining on the one hand and the manufacturing sector on the other [1]. The four major product groups of the semis sector are wire (incl. wirerod), plates, sheets and strips (rolled products), rods, bars and sections (extruded products) and tubes (extruded or pierced). The most important alloy is brass (copper/zinc).

III.1 The geographical distribution of production

The available statistics on production of copper and copper alloys in the market economies indicate that total production reached a level of 9.2 million tons around 1980, but that production declined in the economic crisis of the early eighties (Table 9) [2]. Besides, according to these figures, the developing countries increased their share in fabrication from less than one per cent in 1970 to about 6 per cent in 1982.

TABLE 9

Production of copper semis in the market economies (x 1,000 tons and percentage shares)

	1969/71		1979/81		1982	
	Volume	Percentage	Volume	Percentage	Volume	Percentage
DME	7,106	99	8,721	95	7,868	94
LDC	64	1	475	5	497	6
ME	7,170	100	9,196	100	8,365	100

Source: World Metal Statistics; the final year in the Table is 1982, because data on production in developing countries for 1983 are not yet available

1) The important OECD-fabricators (with those of the USA as the major exception) are organized in the International Wrought Copper Council (IWCC)

2) No data are available for the centrally planned economies

The trends revealed by the statistics on production are correct, but the absolute level of the figures is wrong and particularly so for the developing countries. For these countries the figures appear to be far from complete. Consequently their total production and their share in the production of the market economies are heavily underenumerated.

To get a better picture of the production of copper semis in the developing countries, one has to look for an approximate figure. The basis for this approximation is the fact that all refined copper (both primary and secundary refined) is being used (consumed) for the production of semis. To this tonnage one would have to add the major part of the direct scrap used. It is estimated that of all the direct scrap used in the OECD-countries, between 25 and 35 per cent is being consumed by foundries. Exact figures are unknown, however. On the other hand, to the figure of refined consumption plus direct scrap used in the production of semis, one would have to add the tonnage of alloy materials being used. Again, exact figures are unknown, and estimates come up with figures between 20 and 25% of the weight of copper alloy semis. Given these uncertainties, we do not deduct a tonnage for the direct scrap used by foundries and we do not add a figure for the use of alloy material in the production of semis. In the absence of data for the developing countries, the production of copper and copper alloy semis is estimated by adding the consumption (use) of refined copper and the use of direct scrap. By comparing Table 9 (data on semis production) and Table 10 (estimated semis production), it is shown that, for the industrialized countries at least, the two sets of figures are pretty close.

These data indicate that in 1970 the production of copper and copper alloy semis in the developing countries was still at the very low level of 380,000 tons, less than 5 per cent of the production of the market economies. In the seventies, however, their production almost trebled and reached a level of about 1 million tons. At the same time, production increased very slowly in the industrialized countries, on average at a rate of 1.5 per cent per year. The equi-

TABLE 10

Refined consumption plus use of direct scrap in the market economies (x 1,000 tons and percentage shares)

	Developed Countr. Volume	percentage	Developing Countr. Volume	percentage	Market Economies Volum	percentage
1949/51	3,557	97	114	3	3,671	100
1959/61	5,161	97	182	3	5,343	100
1969/71	7,565	95	382	5	7,947	100
1979/81	8,796	90	1,003	10	9,799	100
1982	8,032	88	1,061	12	9,093	100

Source: Statistical Annex

valent growth rate in the developing countries, however, was 11 per cent per year. Consequently, the developing countries increased their share in the production of the market economies to 10 per cent around 1980.

The presented figures confirm the fact that the developing countries are the major growth-market for copper semis. The markets in the industrialized countries seem more or less saturated. The developing countries, or at least a number of them, are catching up.

Among the industrialized countries, Europe has traditionally been the most important producing area of copper alloy semis. Its share in the production of the industrialized countries has over the past 15 years remained about constant at a level of just over 45 per cent (Table 11). The Federal Republic of Germany is the most important European producer country with a production of well over 1 million tons per year.

The share of North America in the production of the industrialized countries declined from 36 per cent around 1970 to 30 per cent in

TABLE 11

Production of semis in the developed market economies (x 1,000 tons and percentage shares)

	1969/71		1979/81		1983	
	Volume	Percentage	Volume	Percentage	Volume	Percentage
Europe	3,287	46	4,004	46	3,772	47
North America	2,530	36	2,828	32	2,459	30
Japan	1,190	17	1,790	21	1,783	22
Australia	100	1	99	1	89	1
TOTAL	7,107	100	8,721	100	8,103	100

Source: World Metal Statistics

1983. In the USA, the production of copper semis declined by more than half a million tons between 1977 and 1983. Nevertheless, the USA still is the largest producer country in the world.
In the nineteen seventies, Japan realized the highest growth rate among the industrialized countries and its production share increased to 22% in 1983. Witk a production of 1.8 million tons it approaches the level of the USA.

Around 1970, when production of copper semis was just starting to expand rapidly in the developing countries, the share of Africa was very small: less than five per cent (Table 12). With a very limited expansion of production since that time, this situation did not change. Production of copper semis in developing Africa is at an extremely low level of 25,000 to 30,000 tons per year [1].
Around 1970 the production of copper semis of the developing counries was heavily concentrated in Latin America. Production in this continent increased quite rapidly in the seventies, doubling in one

---

1) The figures on refined consumption are not complete, for instance in the case of Zambia; correction for such omissions would, however, not basically change the picture

decade (Brazil, Mexico). However, production in Asia (incl. Taiwan and South Korea) increased five-fold during the same period. In the world economic crisis of the early eighties, production declined substantially in Latin America, but continued to grow in Asia. Presently this region is the most important one.

TABLE 12

Production of copper semis in the developing countries as indicated by refined consumption plus use of direct scrap (x 1,000 tons and percentage shares)

	1969/71		1979/81		1983	
	Volume	Percentage	Volume	Percentage	Volume	Percentage
Africa	18	5	29	3	25	3
Asia	84	22	413	41	582	57
Latin America	279	73	561	56	408	40
TOTAL	382	100	1,003	100	1,015	100

Source: Statictical Annex and World Metal Statistics

The very limited production in Africa, the mentioning of Brazil and Mexico in the case of Latin America and the recent prominence of Asia all indicate that in the developing countries fabrication of copper is first of all linked to industrialization in general and not to the mineral and metallurgical production of copper [1].

---

1) See Paragraph III.3

III.2 The characteristics of the copper semis sector

The products

Copper semis are being produced by wire mills, brass mills and foundries. Because foundries are typically producing for small local markets, producing tailor-made products for their customers, this sector will not be analyzed here [1].

The production of the wire mills and brass mills consists on average for about 65 per cent of products made of pure copper, the remainder being copper alloy semis (Table 13). Wire constitutes about 50 per cent of total production. Rods, bars, etc. and plates each account for about 20% of output and tubes, with a share in production of just over 10 per cent, form the smallest category.

TABLE 13

Composition of the production of wire and brass mills, 1983 (percentages)

	Pure copper	Copper alloys	Total
Wire	47	2	49
Rods, bars and sections	2	18	20
Plates, sheet and strips	7	12	19
Tubes	9	3	12
	65	35	100

Source: International Wrought Copper Council, Annual Report 1983-4,p.8
Figures are for apparent domest consumption in all major Western countries, excluding the USA

---

1) In the USA foundries consume 10 per cent of the refined copper and copper alloy ingots; Copper, 1983, Bureau of Mines, Washington, p. 10

The production of the wire mills consists for about 95% out of products made of pure copper. This is different for the brass mills, as the name already indicates. About 65 per cent of their output consists of semis made of copper alloys. Rods, bars, etc. are their most important product category, with a share in total output volume of almost 40 per cent. Plates, etc. come close in second place and tubes are, with a share of about 25 per cent, the smallest category [1].

Copper semis are being used in a wide variety of final products, from valves and fittings to transformers for the railways and many other products, like air-conditioners, refrigerators, powercables, telecommunication equipment, lamp caps, roofing, radios, vacuum cleaners, radiators, propellers (for ships), electric motors, etc., etc.. Only in the United States data are systematically being collected on the end-use of copper products by sectors (Table 14). About 50 per cent of the end-use is, as might be expected, for electric purposes.However, a large part of this consumption does not take place in this industrial sector as such, but for about 20% in building/construction and for another 20% in other sectors. About 60 per cent of the end-use of copper takes place in the two just mentioned sectors.

The wide variety of final products does of course have certain repercussions for the composition of the output of the copper and copper alloy semis sector. However, the situation is different for the wire mills as compared to the brass mills. Therefore, the two subsectors will be dealt with separately.

The processes

Only fifteen years ago the production of copper wire started with the fabrication of hot rolled rod from wire bars. Nowadays the most common process is the fabrication of continuously cast rod (CCR) di-

---

1) Calculated from Table 13

TABLE 14

Copper consumption in the United States by end-use sector, 1981

End-use industry sector	Electrical uses (Sector 1) vs.non-electrical uses (sectors 2-5)	Electrical uses distributed through all sectors
1) Electrical/ electronic	53%	30%
2) Building/construction	20	29
3) Industrial machinery and equipment	13	17
4) Transportation	8	12
5) Consumer and general prod.	6	12
	100	100

Source: Copper 1983, Bureau of Mines, Washington, p. 10

rectly from cathodes. Subsequently, wire is drawn to the desired diameter. Wire is being traded between firms, with the producers of electrical apparatus, using the wire for windings, as the main buyers. However, a very large part of all wire produced is being used for the production of insulated wires and cables. Most of the wire these manufacturers use is being fabricated by themselves: "cable makers are increasingly able to draw their own wire from wirerod"[1]. Consequently wire rod is the only semi-manufacture of importance in this sector. Wire rod is a standardized, homogeneous product [2].

---

1) Balon, R.: "The copper semis industry", in Copper 1983, London, 1983, p. 3.2
2) It should be noted that with additional immediate drawing of the wire rod after continuous casting, the distinction between wire and wire rod is being blurred

Of course there are differences in quality, due to the quality of the refined copper that is being used.

Production of continuous cast rod (CCR) is relatively not very capital-intensive and the technology to be applied is not very sophisticated, but a rather simple one. The importance of economies of scale is not very clear.

Compared with mining, smelting and refining, the production of CCR is not very capital-intensive. Required capital investments are estimated at $ 70-100 per ton annual capacity [1], to be compared with $ 5,000-6,000 for mining, $ 1,500-2,000 for smelting and $ 400-600 for refining. The value added in CCR-production is also not very high, as CCR fetches a premium over refined copper of about $ 100 per ton; value added is at a level of about 6 per cent over refined. However, taking into account the higher value added in refining, it turns out that investment per unit of value added in CCR-production is less than half the investment in refining.

The design and development of the technology of continuous casting is to be considered as a sophisticated accomplishment of modern technology. Different production systems have been developed, like Southwire, Contirod, Lamitref and Outokumpu. However, the operation of the installation is not very complicated and has been referred to as "the relative simplicity of the rod-making operation" [2].

No studies are available on the economies of scale in CCR-production. A preliminary estimate indicated that for a very small Outokumpu installation (6,000 tons annual capacity) the investment costs per unit of output are considerably higher than for a large Southwire plant (150,000 tons). However, it seems also very likely that these diseconomies of scale of a small Outokumpu installation would substantially be redressed at a somewhat larger scale of production (e.g. 18,000 or 24,000 tons). This issue clearly requires further investigation, particularly because it is highly relevant

---

1) Balon, op.cit., in Copper 1983, p. 3.8
2) Copper Studies, December 16, 1975, p. 3

for the feasibility of production in developing countries.

Required investments per ton of output for a brass mill (extrusion of shapes, rolling mill, tube mill) are definitely higher than for CCR. For a tube mill they have recently been estimated at $ 800-1,000 per ton of annual capacity and for a rolling mill at $ 1,000-1,500 [1]. This does not mean that also the investments per unit of value added are higher than for CCR. The contrary seems to be the case. Value added per ton is easily 15 times higher for brass mills than for continuous casting of rod [2]. Brass mills are most likely less capital intensive per unit of value added than continuous casting.

No studies are known regarding economies of scale in brass mills. It seems to us that economies of scale start to taper off at a rather low level of capacity. In some developing countries, rolling mills do exist with an annual capacity of less than 5,000 tons and tube mills with an even lower capacity [3]. As with CCR-production, the issue of economies of scale for brass mills requires further investigation.

An important issue with respect to the character of the brass mills industry concerns the homogeneity of the products and the sophistication of the technology. Are we dealing with heterogeneous products, produced with a complicated technology or with standard products and quite simple techniques ? The literature is not giving a clearcut answer to these questions.

It is a fact that the basic technologies of extrusion, rolling and piercing (of tube) are "old", quite simple and universally known [4]. On the other hand, it is being stressed quite often that brass mill

---

1) Balon, op.cit., in Copper 1983, p. 3.8
2) UNCTAD, for example, sets the price for sheet at 185 per cent of the price of refined copper; UNCTAD, op.cit., 1982, p. 58
3) Vingerhoets, J. and A. Sannen: "Fabrication of copper semi-manufactures in Zambia", Tilburg, 1985, p. 73-74
4) This is not the case with new (experimental) technologies like continuous casting of shapes and welding of tubes

products are highly specialized and have to be made to customer specifications [1], and that tube manufacturers, for instance, "develop areas of specialties" [2]. Consequently, it is asserted that "production of tube, especially alloy tube, is an extremely specialized process, requiring a high level of expertise" [3].
It is beyond any doubt that the brass mill industry produces a wide variety of products. Many of these products, however, are standardized [4].
One example is Industrial Tube (halfhard -harddrawn) with about 25 standard measures. Another example is Brass Sheet (soft, deep drawing quality) with 16 standard measures. On the other hand, mills produce specialty products (for instance copper alloy industrial tube, or specialty alloy strip for the electronics industry).
Recent developments in the industry seem to accentuate the distinction between standard products and specialty products. In the USA some large mills have recently shifted their attention from standardized products to specialty products. The brass mills that produce "high-volume bread-and-butter products" [5] seem to have become more vulnerable than the producers of specialties. This development could be of importance for potential developing country exporters.

The structure of the sector

Prain's statement that there are thousands of copper fabricating plants in the world, is most likely correct [6]. The implicit suggestion that there are many atomistic suppliers in a market with "perfect competition" is, however, not correct. Certainly, the copper

---

1) Copper Studies, October 3, 1975, p. 1
2) Copper Studies, December 16, 1975, p. 1
3) Copper Studies, December 16, 1975, p. 2
4) A German expert from within the industry estimates that 90% of the production of the brass mills consists of standard products
5) Copper Studies, August 1984, p. 9
6) Prain, op.cit., 1975, p. 114

fabricating industry is not as highly concentrated as mining, smelting and refining. Besides, there is generally not a high degree of integration from mining through to fabricating. Nevertheless, it seems justified to speak of an oligopolistic structure of the industry. In the subsectors (wire mills, general brass mills, tube mills, rolling mills) the regional markets are dominated by a limited number of firms [1]. There is also a farily high degree of vertical integration between certain stages in the production chain. However, our findings have to be treated with some caution. It is difficult to gain a good knowledge on the market position of firms and on all the linkages between major firms and their respective subsidiaries. Factors like these probably also explain why a study dealing extensively with the structure of the copper fabricating sector, does not exist.

Comparing the production capacity of the largest fabricating companies with those of mining/smelting/refining companies, the conclusion is easily reached that the level of concentration is smaller in the copper fabricating sector. Some ten years ago, for instance, the nine largest copper fabricating companies outside the USA had a production capacity of 2.6 million tons, half the capacity of the nine leading mining companies [2]. In 1974, the 25 major copper fabricators, including the US-companies, had a capacity of 4.3 million tons, 55 per cent of the estimated total of the market economies [3].

With respect to vertical integration, the situation is different in the USA, Japan and Europe. "Of most direct interest are ownership links between refineries and semi-fabricating establishments. Large proportions of the production of Japanese and North American refineries and of the output of some European refineries are sold to semi-

---

1) Regionalization of markets, in turn, is influenced by integration, close seller-customer relationships and trade barriers; the two last mentioned subjects will be dealt with below
2) Derived from Labys, op.cit., 1980, p. 87-89
3) See The General Annex, Table III

fabricators within the same ownership group, and nearly all of the firms engaged in such transactions are relatively large on both sides" [1]. In Japan the high level of vertical integration does not include (directly) the mining stage [2]. In the USA the vertical integration with mining companies is most important. In 1969, four of the seven largest brass mills and four of the eleven largest wire mills were controlled by integrated producers [3]. Anaconda, Phelps Dodge, Kennecott and Asarco together possessed at that time about 65 per cent of the fabricating capacity in the USA [4]. However, in the USA, backward integration is also important, because "the majority of the 'independent' mills are actually subsidiaries of such huge manufacturing firms as General Motors and Westinghouse" [5]. In Europe, vertical integration is rather limited compared to Japan and the USA; of greatest importance seems to be the integration between custom refiners and fabricators.

It is highly relevant to look at the copper fabricating industry as a whole when analysing the market for refined copper. When studying the possibilities of partial (relative) relocation of fabrication of semis to developing countries, the segmentation of the fabricating sector is more relevant. The sub-sector of the wire mills is quite different from the brass mills. In the case of wire mills there is only one homogeneous semi-product and for the brass mills a wide variety. The wire and cable industry is a separate sector, not linked with the many sectors using the output of the brass mills. A further subdivision of the brass mills would not be correct at this juncture, because a number of firms produce both shapes, tubes and plates. For this reason we deal separately, but briefly, with the structure of the brass mill sector and of the wire mill sector.

---

1) Gluschke, Shaw and Varon, op.cit., 1979, p. XXI
2) The involvement of Japanese smelters/refiners with mining overseas could be considered as backward integration, but it is mostly in a rather indirect way with relatively little equity ownership
3) Becker, op.cit., 1983, p. 75
4) Banks, F.: "The world copper market: an economic analysis", Ballinger, Cambridge (Mass.), 1974, p. 27
5) Becker, op.cit., 1983, p. 75

The brass mill sector

The major producing countries of brass mill products are the USA, Japan, Germany FR, Italy, the UK and France. In the USA, with a production of about 1 million tons per year, the six leading companies presently are Arco, Revere Copper and Brass, Chase, Phelps Dodge, Bridgeport Brass and Scovill [1]. These companies all produce a wide range of shapes, plates and tubes. Another five large producers fabricate one or two of the three product categories. Four of the six largest fabricators and one of the next group are integrated with mining/refining companies. Several of them operate factories outside the USA, but only to a limited extent in developing countries.
The major producers in Japan are Sumitomo, Furukawa, Mitsubishi and Kobe Steel. The first three companies are integrated with refining. Their fabricating activities are (almost) completely confined to Japan.
In Europe, Germany is the largest producer country with an output of about 600,000 tons per year. The three leading companies are Diehl, Gutehoffnungshütte and Metallgesellschaft. The two last mentioned companies are (partly through links with the Norddeutsche Affinerie) integrated with refining. Seven other rather important producers of brass mill products are not integrated with refining. In France, Péchiney Ugine Kuhlman is the only major integrated fabricator. The two largest companies in this sector in the UK are Delta Metal and Imperial Metal Industries (IMI). General Electric, British Insulated Callender's Cables (BICC), Rio Tinto Zinc and Péchiney also produce brass mill products in the United Kingdom. IMI and BICC are (partially) integrated with refining. In Italy the major fabricators are Carlo Gnutti and Metalli Industriale. They are not integrated with refining.
A brief review of the major producers only can serve as a first indication of the structure of the markets. The West European market is the one with relatively the lowest degrees of integration and

---

1) Data on brass mills and wire mills have mainly been derived from an unpublished masters thesis by Jos Smeehuijzen

concentration. Even in this case, however, there seems to be an oligopolistic structure. The tube market may serve as an example. "Common features of the West European tube industry include the self-sufficiency of domestic markets in most cases and the domination of such by a number of relatively large producers, located close to the consuming centers" [1]. The relevance of concentration and integration for partial relocation of the industry to developing countries is twofold. With a high level of concentration it is difficult for an "outsider" to penetrate the market. Secondly, integration, be it forward or backward, is a factor discouraging relocation of part of the production chain. For producers in developing countries wanting to set up export-oriented production in cooperation (a joint venture) with a Western company, it would therefore seem to be most advisable to join forces with a non-integrated fabricator.

The wire mill sector

In the wire and cable industry, concentration and vertical integration are at a higher level than in the brass mill sector; "the cable industry is highly oligopolistic" [2]. The major producer countries are the same as in the case of brass mills, plus Belgium. The three largest producers in the USA are Anaconda-Ericsson, Phelps Dodge (very active abroad) and GK Technologies (formerly General Cable). All three companies used to be integrated with mining companies. For GK Technologies this is no longer the case. Among the remaining producers several are either forward or backward integrated: Asarco, Cerro Wire, Newmont Mining, Scovill and Westinghouse.
The wire and cable industry in Germany is dominated by Metallgesellschaft and Gutehoffnungshütte, both integrated with refining. AEG and Philips are examples of backward integration. In France the major producers are Courbevoie and Sté. Laminoires Tréfileries Câbleries de Lens; both companies are not (directly) integrated with

---

1) Copper Studies, December 16, 1975, p. 1
2) Banks, op.cit., 1975, p. 9

refining. The largest wire and cable company of the world is the UK-based BICC, partially integrated with refining and operating in several countries. Other important producers in the UK are the Delta Group, General Electric and IMI. The two largest producers in Italy are Colata Continua and Metalrome. The best known Italian producer is Pirelli. Almost all activities of this company, however, take place outside Italy, particularly in South America, Canada, the USA and the UK. The major producer in Belgium is Métallurgie Hoboken-Overpelt, belonging to the Société Générale Group. With a CCR-capacity of 250,000 tons, the company is one of the largest producers of this product in the world. Hoboken-Overpelt is integrated with refining and partially integrated with the wire and cable industry.
The six major producers of wire and cable in Japan are Sumitomo, Furukawa, Numazu, Mitsubishi, Hitachi and Showa. Except for the last two companies mentioned, they are all directly integrated with refining. Some of them (Sumitomo, Hitachi) actively participate in production abroad (South East Asia).

The CCR-technology has changed the structure of the wire and cable sector to a certain extent. Traditionally, the hot rolling mills were generally integrated/affiliated with the fabricators of insulated wire and cable (the cable makers). CCR-mills could either be integrated with the cable makers or with the refineries. For the first time rod mills became to a significant degree integrated with refineries. Particularly European custom refineries added CCR to their facilities. Advantages of integration with refineries are: large scale investments are better justified with a number of wire mills as customers and refineries are more certain of a regular supply of high quality cathode that is required for CCR-production. As a consequence, in 1979, custom refiners and primary producers together accounted for 46 per cent of CCR-capacity, 40 per cent was owned by fabricators and the remaining 14 per cent was under mixed

ownership. It is therefore concluded that "increasingly, continuous cast rod is viewed as another refinery shape, rather than as a semi-manufactured product" [1].

For the mines/refineries in the developing countries CCR is apparently not (yet ?) a "refinery shape". Zambia participates in a joint venture with Thomson-Brandt in France and Codelco (Chile) became a partner in a CCR-joint venture with Deutsche Giessdraht and in one with Sté. Lensoise de Cuivre (France). For the European companies concerned, these joint ventures offer the advantage of an assured supply of high quality cathode. The advantage for Zambia and Chile is an assured outlet for refined copper and a share in the profits. However, it would have been more advantageous for these countries to have the CCR-plants located within their boundaries. In that case the additional advantages would have been: the income earned and the employment created in the construction stage, the local availability of wire rod, a broader tax base, creation of employment and increased foreign exchange earnings.

So, the question remains: why is CCR not a "refinery shape" for the developing countries ? May be technical factors are of importance in this case [2], but the institutional factor of the market structure also seems to be relevant. Fabricators wanted to continue the production of wire rod when they had to switch from HRR to CCR. Custom refiners and primary producers, (partly) integrated with fabricators, of course preferred location at their refineries. Within the logic of the structure of the sector, there was, in the absence of important advantages of location in developing countries, no room for attaching CCR-production to the refineries in the developing countries. Their position was further weakened by the stagnation of the copper market since 1974 and the resulting overcapacity in the sector. These countries had to give in (or did so willingly) and they opted for the "second best" solution of participation in production in the industrialized countries.

---

1) Copper Studies, October 1979, p. 2
2) We come back to this point in Chapter V below

III.3 Production of semis in developing countries: the dominance of import substitution [1]

Of only four developing countries are figures on production of copper semis included in the global statistics [2]. Besides, the data on the use of direct scrap are only given for the continents and not for individual countries (except for Brazil in recent years). Consequently, the best indication of the distrubution of the production of copper semis among the developing countries is to be found in the figures on consumption of refined copper.

The production of copper semis in the developing countries is almost completely confined to Latin America and Asia (see also Par. III.1 above). Four countries accounted in 1979/81 for two-thirds of the fabrication of copper semis: Brazil, Mexico, South Korea and Taiwan [3]. Adding two more countries, India and Argentina, the share in the production of the developing countries passes the 80 per cent level. The share of the Asian countries, including those in South East Asia, is on the increase. In contrast, the production of the traditional copper exporting countries (Chile, Peru, Zambia and Zaïre) accounts for just over 8 per cent of the total.

The data show that import substitution has been the major tendency, in those developing countries that realized rapid industrialization in the past decade and a half [4]. As is well known, industrial growth has been most rapid in the export oriented so-called Newly Industrializing Countries (NIC's) [5]. Whatever definition is used, Taiwan, South Korea, Brazil and Mexico certainly belong to this group.

---

1) This phenomenonn is also being referred to as backward integration; this is correct when looked at from a national economic point of view; however, we do not use the term in order to avoid confusion with integration between firms
2) See Table 9 of the Statistical Annex
3) 1979/81 is considered to give a better impression of the strucrural situation than 1983, because of the severe recession in Latin America
4) Analysed by Perlman, R.: "Kupferverbrauch in Entwicklungsländern", in Metall, Januar 1982, and in Copper Studies, April 30, 1981
5) Or: countries are considered to belong to the group of the NIC's because they realized rapid industrial growth

In Taiwan and South Korea the copper semis sector is completely based on imported raw materials; the countries do have some refinery capacity but no mining. Brazil does have a relatively small mining capacity and a somewhat larger refinery output. Only in Mexico the mine production (but not the refinery production) is larger than the semis production.

In the NIC's, not only industrial growth as such, but also the composition of that growth has stimulated the demand for copper. Electrification and the electrical and electronics sectors have generally been growing at above average rates. Consequently, there has been a very rapid growth in demand for products from the wire and cable industry and such an industry has usually been set up as soon as domestic demand justified a sufficient level of production to avoid diseconomies of scale. Subsequently, CCR-production has been started in many developing countries. Plants for continuous casting of wire rod have been installed in Argentina, Brazil, Indonesia, Iran, South Korea, Malaysia, Mexico, the Philippines, Taiwan and Thailand [1]. Zambia is the only one of the traditional copper countries having a CCR-factory, be it a very small one.

In rapidly industrializing developing countries, demand for brass mill products has in all cases been stimulated by rapid growth of the construction industry and in some cases by rapid growth of the motor vehicle industry. As regards brass mill products, the countries concerned have, however, to a larger extent and/or for a longer period, been relying on imports. Perlman attributes this mainly to the fact that the domestic end-users demand a wide variety of brass mill products [2].

Chile has the largest semis sector of the traditional copper exporting countries. Around 1970 production was at a level of 22 thousand tons and this output figure doubled in the seventies, but production has declined markedly in the early eighties. The major point, how-

---

1) Metal Bulletin Monthly, August 1983, p. 34-37
2) Perlman, op.cit., 1982, p. 80

ever, is that output expansion in the seventies did not even keep pace with the average expansion in the developing countries. May be this is partly explained by the fact that Chile decided to participate in joint ventures for CCR-production in Europe. Within Chile, two firms operate in the wire and cable sector: Cobre Cerillos SA (a subsidiary of Phelps Dodge) and Manufactura de Cobre SA (Madeco). The last mentioned company also produces plates and tubes. The other two companies (rather small ones) in the brass mill sector are Armat Metalurgica Saic, and Coplasa.

In Peru the consumption of refined copper increased five fold in the seventies, but still did not yet reach 20,000 tons at the end of the decade. The state company Centromin owns a wire rod (HRR) capacity of 22,000 tons. Cables y Conductores de Cobre SA is a small wire and cable manufacturer. The three companies in the brass mill sector are Coplasa-Industria Metalúrgica SA, Inamesa and Metales Industriales del Perú SA. Together they have a rated capacity of 24,000 tons.

Mexico, exporting almost 200,000 tons of concentrates (Cu-content) in 1983, is a special case. The country is a NIC and a new copper exporter (large scale exports of concentrates only started in 1980). Refined consumption (production of semis) reached a level of 130,000 tons in 1981, but dropped to 80,000 tons in 1983, resulting in a surplus capacity that could be used for export production [1]. With an increased refinery capacity, exports of copper semis could become a more structural feature of the Mexican copper sector.

The largest company in the wire and cable sector in Mexico is Condumex (CCR-production), with Pirelli as the major partner. Other companies in this sector are Conelec (subsidiary of Phelps Dodge) and Industrias Nacobre (40% Atlantic Richfield). The last mentioned company also produces brass mill semis. The other company in this sector is Cia de Real del Monte y Pachuca SA (a state company).

---

1) See Chapter IV

The only semis production of the African copper exporters that is worth mentioning is the 6,000 ton Outokumpu CCR-capacity of Zamefa in Zambia (1982). The company is a joint venture of a state company with several foreign partners, of which Phelps Dodge is the major one [1].

Finally, mention is made of the copper semis production in the "new" exporting Asian countries, Indonesia and the Philippines. In the Philippines refined consumption was only 3,400 tons in 1979/81 and Indonesia is not even mentioned in the statistics. However, in Indonesia a CCR-plant has been installed in 1979 with an annual capacity of 36,000 tons. Furukawa is the majority owner. In the Philippines a CCR-plant (Outokumpu, 6,000 tons capacity) has very recently been built by Phelps Dodge. American Wire and Cable (GK Technologies) is the other company in this sector.

---

1) Vingerhoets and Sannen, op.cit., 1985

CHAPTER IV

International trade in copper semis

The volume of international trade in copper semis is limited by several factors. The first factor is transport costs. The second sector concerns the structure of the market; concentration and vertical integration limit international trade. The third factor is that of trade barriers imposed by governments.
In this chapter we concentrate on the analysis of the international trade flows and we include a brief review of the literature on trade barriers. The structure of the sector has already been dealt with above. The subject of transport costs will be considered in the next chapter.
The central thesis to be found in the literature is that international trade in copper semis is only of a limited nature and not very important. It is asserted "that production of semi-fabricated products is only marginally trade-oriented" [1] and that "world trade in semi-manufactured copper products has been mostly intra-region"[2]. Is this thesis still correct or is a certain revision in order ? In addressing this question we focus our attention on the developing countries both as importers and as exporters of copper and copper alloy semis.

IV.1 The general pattern of world trade

In 1983 the total semis exports of the seventeen countries registered in World Metal Statistics amounted to just over 1.6 million tons [3]. Taking into account that countries like Yugoslavia, Taiwan,

---

1) Kirthisingha, op.cit., 1982
2) Copper Studies, December 4, 1975, p. 1
3) The countries are: Australia, Austria, Belgium, Canada, the Scandinavian Countries, France, Germany FR, Italy, Japan, the Netherlands, Spain, Switzerland, the United Kingdom and the USA

Chile, Mexico, Peru, etc. also export copper semis, total exports of the world market economies were certainly over 1.7 millions tons in 1983. Unfortunately there are no data available on the value of these exports. The most recent figures on the value of exports relate to 1980 and 1981 and are respectively 4.7 and 3.9 billion US $ [1]. The value of exports in 1983 was probably in the order of 4 billion US $.

Figures on the distribution of exports and imports between developing countries and developed market economies are only available in value terms [2]. These data indicate clearly that the share of the developing countries in world exports is very small: about 3.5% in 1980 and 4.5% in 1981. Presently, about 95% of the exports of the market economies originates in the industrialized countries. In contrast, the developing countries have a substantial share in the imports of the market economies: 24 per cent in 1980 and 27 per cent in 1981. It is estimated that the developing countries presently run a "trade deficit" in copper semis of about US $ 1 billion.

Despite data limitations, an analysis of available statistics indicates that the copper semis industry has become much more internationally oriented over the past decade and a half. Exports have increased more rapidly than production. An increasingly larger part of total production is being exported (Table 15). Besides, trade in copper semis has increased more rapidly than trade in refined copper.

In 1968 the international trade in copper semis was exactly equal to one quarter of the international trade in refined copper. Fifteen years later the semis exports of the major Western producer countries were equal to more than half the world trade in refined copper. Confining the attention to the semis as such, the most important

---

1) Yearbook of International Trade Statistics 1982, UN, New York, 1984; the copper prices were in 1981 on average about 20 per cent lower than in 1980

2) Calculated from International Trade Statistics, adding the country data on SITC 682.21, 682.22 and 682.25; adjusted for Taiwan

TABLE 15

International trade in copper semis related to trade in refined copper and to production of semis (percentages)

	1968	1975	1983
Exports of semis as percentage of trade in refined copper	25	36	53
Exports of semis as percentage of production of semis	9	14	20

Source: World Metal Statistics; data pertain to the 18 (for 1983: 17) major Western producer countries; they produced almost 8 million tons of copper semis in 1983

phenomenon observed is the trend towards more and more of the semis production being exported. In 1968 this was still the case with less than ten per cent, but in 1983 twenty per cent of the production was being exported. This is an average figure, with great differences between countries. Exports as a percentage of production vary from 88 per cent in the case of Belgium to 2 per cent for the USA; in between these two extremes are, for example, the Netherlands (58%), France (41%), Germany FR (36%), the United Kingdom (18%) and Japan (12%).

Do these figures justify the quoted characterization that the sector is "only marginally trade-oriented" ? To us this judgement seems out of date. When on average 20 per cent of production is being exported, this can hardly be called "marginal", and this is certainly not the case for a number of individual countries. Besides, the rapid increase in exports seems highly relevant. Over the period 1968-1983 the increase in exports of the major Western countries was almost

equal to 80% of the increase in the production of these countries. The expansion of production has been very heavily oriented towards exports.

With CCR becoming a "refinery product", international trade in wire rod has expanded rapidly. Does this factor account for the increase in copper semis trade ? For six major Western countries data are available on both production and exports by product category: Canada, France, Germany FR, the United Kingdom and the USA. Together they produced 6.4 million tons of copper semis in 1983 (seventy per cent of the production of the market economies).

In the six countries production expanded at a very modest pace, but exports increased quite rapidly (Table 16). Exports of wire (rod) expanded most rapidly, accounting for about 50 per cent of the total increase in exports (700,000 tons). However, also the exports of other semis increased much more rapidly than production; while the production of other semis increased by only 150,000 tons, the exports of these products increased by 350,000 tons. Not only the production of wire rod, but also the production of other semis has become more oriented towards exports.

TABLE 16

Average annual growth rates of production and exports of copper semis in six Western countries, 1968-1983

	Production	Exports
All semis	1.1	8.1
Wire	1.9	13.3
Other semis	0.3	6.1

Source: World Metal Statistics

The rapid increase in exports of wire rod has not resulted in the production of wire (rod) being more export-oriented than the pro-

duction of other semis (Table 17). The export-orientation of wire rod production has merely been catching up with that of the other semis. Consequently, the composition of exports has become very similar to the composition of production.

TABLE 17

Composition of production (1983) and exports of semis (1981) (percentages)

	Production	Exports
Wire	49	45
Rods, bars and sections	20	16
Plates, sheet and and strips	19	24
Tubes	12	15
	100	100

Source: Table 13 above (production) and International Wrought Copper Council; "World Trade in Copper and Copper Alloy Semi-manufactures, 1981" (exports)

IV.2 The exports of the industrialized countries and the imports of the developing countries

Exports of industrialized countries

Detailed data on exports and imports of copper semis are available to us for the year 1981. The data, compiled by the IWCC and including detailed export/import matrices by product categories, are based on export and import figures for 24 countries (the Western exporting countries plus South Korea and Taiwan). The exports of each one of these countries to Eastern Europe and to the developing countries have been added and the resulting figures for these

countries are being registered as their imports. This is correct, but one has to be careful: whenever in this paragraph reference is made to imports of developing countries, this is shorthand for imports originating in the 24 countries for which exports have been recorded.

In 1981 the developed market economies (DME) exported more than 1.6 million tons of copper and copper alloy semis (Table 18). From other DME, they imported over 1.2 million tons. Consequently, almost 400,000 tons of their exports went to countries outside the group of developed market economies.

TABLE 18

Total exports of copper semis by the developed market economies (DME) and imports from other DME, 1981 (x 1,000 tons and percentage shares)

	Exports Vol.	%	Imports Vol.	%	Net exports - Net imports +
Western Eur.	1,285.3	79	997.0	79	- 308.3
N. America	115.5	7	228.2	19	+ 112.7
Japan	191.1	12	2.5	-	- 188.6
Other DME	37.1	2	26.2	2	- 10.9
Total	1,629.0	100	1,233.9	100	- 395.1

Source: IWCC, World Trade in Copper and Copper Alloy Semi-manufactures 1981. South Korea and Taiwan have been excluded from the import matrix

The Western European countries taken together are the major exporters of copper semis and they also are the major importers from other DME. The net exports of Western Europe amount to over 300,000 tons. In contrast, Northern America is a major net importer of copper semis.

Canada is a small net exporter, but the USA has become the largest importer of copper semis in the world (both gross and net). It seems that it has been rather easy for outsiders to penetrate the American market. This is definitely not the case with Japan. The market is tightly closed and imports are negligible. But with exports approaching 200,000 tons in 1981, Japan is one of the largest exporting countries in the world. Of the other DME (Australia, New Zealand and South Africa) only Australia is a net exporter of any significance, New Zealand being its best customer.
Of the net exports of the DME, some 30,000 tons went to Eastern Europe and to "markets unknown". This leaves 364,000 tons of exports to the developing countries, 22 per cent of the total exports of the developed market economies.

Western Europe has been selected for a more detailed analysis because of two reasons. Western Europe is the major net exporter of copper semis in the world. Besides, in Western Europe we come across the phenomenon of intra-regional trade. This gives an opportunity to pay some attention to the question whether or not "world trade in semi-manufactured copper products has been mostly intra-region"[1]. Two thirds of the Western European exports are being taken care of by only three countries: Germany FR, France and Belgium. Another 14 countries account for the other one third, and all together they exported almost 1.3 million tons of copper semis in 1981. Of these exports almost 75% went to other countries in Western Europe. To get a global picture of intra-regional trade of the developed market economies, one could add to the intra-European exports the exports of the USA to Canada and vice versa, the exports of Japan to South Korea and the exports of the USA to Mexico. Adding all these export and comparing them with the total exports of the DME, it turns out that 63% of the exports is intra-regional. Phrased differently, and this

---

1) Copper Studies, December 4, 1975, p. 1

gives another perspective: 37 per cent of the exports, or 600,000 tons is extra-regional.
However, this picture seems to exaggerate the occurrence of intra-regional trade. All exports within Western Europe are namely considered to be intra-regional, but the region runs from Greece to Portugal, to Ireland and Finland. It seems therefore more appropriate to substitute the figure on intra-European trade for the figure on intra-EEC trade (the EEC of the ten). Not only are these countries geographically closer together, they also form a customs union. Following this procedure it turns out that the figure for intra-regional exports of the DME is reduced to 42%.
From a very careful analysis of intra-regional trade, it would probably be concluded that the figure of 63 per cent is too high and that of 42 per cent too low. May be more than half of total world trade is intra-regional, but a very substantial part of total trade is extra-regional.

In 1981 Western Europe exported 150,000 tons of copper semis to developed countries outside Europe (of which 135,000 tons to the USA), 18,000 tons to Eastern Europe and 160,000 tons to developing countries. Of these 160,000 tons just over 10% was exported to Latin America and 35% to Africa. The developing countries of Asia were the most important markets for Western Europe; these countries took 55% of the Western European exports to developing countries.

The exports of Western Europe to the developing countries consisted in 1981 for a very large part out of wire (rod), over 100,000 tons or 64 per cent of the total (Table 19). Consequently, more than 70 per cent of the exports consisted of semis made of pure copper. Besides, it is rather striking that the category of plates, sheets and strips figures quite prominently in the exports.

TABLE 19

Composition of the copper semis ecports of Western Europe to developing countries, 1981 (x 1000 tons and percentage shares)

	Pure copper Vol.	%	Copper alloys Vol.	%	Total Vol.	%
Wire	96.5	61	4.9	3	101.3	64
Shopes (rods, etc.)	4.5	3	13.6	8	18.1	11
Plates,etc.	8.7	6	17.8	11	26.6	17
Tubes	5.0	3	8.0	5	13.0	8
Total	114.7	73	44.3	27	159.0	100

Source: Calculated from the import/export matrices in IWCC, World Trade in Copper and Copper Alloy Semi-manufactures - 1981

The exports of the industrialized countries are to a certain extent being limited by tariff and non-tariff barriers. In the literature, however, not much attention is being given to trade barriers. This is particularly the case with respect to non-tariff barriers. Only in passing reference is made to "the stringent technical and quality specifications for copper semis which are often set by developed country governments, and which may be changed radically over time"[1]. It is highly unlikely that those developing countries that do not produce (certain) copper semis themselves, impose trade barriers on imports. It is, after all, in their own economic interest that imports reach their consumers (manufacturers) at the lowest possible price. The situation is different for those developing countries that have practiced import-substitution in copper semis. Protection of the

1) Copper Studies, October 1975, p. 5

domestic fabricator(s) is in that case very likely, as is apparent in Brazil [1]. Consequently, imports from industrialized countries (and other developing countries) are being limited or even almost prohibited for certain product categories.

Trade in copper semis between the industrialized countries is definitely being limited by import tariffs. In this respect there is a great difference between the EEC and Japan on the one hand and the USA on the other. In Japan, nominal tariffs are generally at a level of 15 per cent and in the EEC at a level of 8 per cent [2]. However, these quite modest nominal tariffs result in very high effective tariffs for certain products. In the case of wire rod, the resulting effective tariffs are in the order of 125 to 150 per cent [3]. They certainly prohibit imports of wire rod. The effective tariffs for the other products are significantly lower. For a product like sheet, however, they still are at a level of around 20 per cent. These effective tariffs seem an important impediment to imports in the EEC and Japan. They also throw some additional light on the intra-regional trade in Western Europe. In the EEC 86% of all imports in 1981 originated in other countries of the customs union. Most likely the tariff barriers were among the factors limiting the imports from third countries.

Tariff protection is much lower in the USA. The effective tariff on wire rod (pre Tokyo Round) is about 15 per cent. The effective tariffs on other semis are generally appreciably lower. Because of these modest tariffs, already some years ago it was concluded that in the USA trade barriers hardly play any role [4]. May be this partly explains why the USA has become an important net importer of copper semis and why Western Europe is in the position to export a substantial amount of copper semis across the Atlantic.

---

1) See Chapter II, above
2) UNCTAD, op.cit., 1982, p. 55-64; reference is made to pre Tokyo Round tariffs; presently these tariffs are in the process of being reduced by, generally, between 15 and 50 per cent
3) UNCTAD, op.cit., 1982; the tariff is related to the value added in the production of wire rod
4) Sheer, H.: "Der Markt für Halbzeug aus Kupfer und -legierungen in Europa und Übersee", in Metall, November 1981, p. 1154

Imports of the developing countries

Measured in value terms, the developing countries had in 1969 a share of about 10 per cent in the imports of copper semis by the market economies. In the early seventies the import share of the developing countries increased rapidly and reached almost 20 per cent in 1974 [1]. In the following years the increase in the import share was less spectacular, but reached nevertheless a level of 27 per cent in 1981. The developing countries have become an important export market for the producers of copper semis.

In 1981 the developing countries imported 384,000 tons of copper semis from the 24 countries for which IWCC recorded the exports. Almost 70 per cent of this total, well over 250,000 tons, was being imported by Asian developing countries (Table 20). Both in Latin America and Africa imports were at a level of about 60,000 tons.

In Asia, the four major importing countries were Hong Kong, Iran, Taiwan and Singapore; together they imported almost 50% of the Asian total. Another five countries imported 25% of the total: Israel, Malaysia, India, Thailand and South Korea.

Mexico and Venezuela accounted in 1981 for 60 per cent of the copper semis imports in Latin America. Other importing countries of some importance in the Latin American context, were Cuba, Colombia and Brazil (but the last mentioned country imported only 1,500 tons of copper semis from the industrialized countries in 1981).

Importing 19,000 tons of copper semis, Algeria accounted for almost one third of the African imports in 1981. Egypt and Nigeria imported together about the same amount. Next came Morocco, Libya and Tunesia. The six mentioned countries imported almost 95 per cent of the African total.

The total imports of the developing countries are estimated to con-

---

1) Source: Yearbook of International Trade Statistics; data pertain to the SITC-codes 68221 and 68225 only. For 1981 the data are complete, because they also include SITC-code 68222

TABLE 20

Imports of copper semis by the developing countries; origin and share in the imports of LDC
(Volumes x 1000 tons)

Origin	Latin America		Developing Asia		Developing Afr.		Developing Count.	
	Volume	Percent.	Volume	Percent.	Volume	Percent.	Volume	Percent.
West. Europe	17.0	30	86.9	33	55.1	90	159.0	41
N. America	34.2	60	12.6	5	1.9	3	48.7	13
Japan	5.4	9	134.1	50	3.9	6	142.4	37
Other countr. *)	0.4	1	33.3	12	0.5	1	34.3	9
Total	57.0	100	265.9	100	61.4	100	384.4	100
Share in the imports of the developing countr.	15%		69%		16%		100%	

Source: IWCC, World Trade in Copper and Copper Alloy semi-manufactures - 1981
*) Australia, South Korea and Taiwan

stitute almost 40 per cent of their own production [1]. Also in this respect the situation is very different in Africa, Asia and Latin America. In Africa the volume of imports is more than two times as large as domestic production. In Asia, domestic production appears to be rapidly approaching a level that is almost double the volume of imports. Latin America, finally, is, in comparison with the other continents, largely self-sufficient: the volume of imports amounts only to just over 10 per cent of domestic production.

Western Europe and Japan each accounted for about 40 per cent of the imports of the developing countries in 1981 (Table 20). Another 20 per cent was being supplied by the USA, Canada, Australia, South Korea and Taiwan. In Latin America almost 50% of the imports came from Northern America (mainly the USA), but, despite the long distances, 30 per cent originated in Western Europe and almost 10 per cent in Japan. In Asia, Japan was, as might be expected, the major supplier, taking care of exactly 50 per cent of the imports. Again it is quite surprising that one third of the imports (87,000 tons) originates in Western Europe. These exports not only go to markets in the Middle East, but quite substantial amounts are being exported to countries like Iran, India, Indonesia, Singapore and even Hong Kong. The imports in Africa are almost completely monopolized by the Western European countries; in 1981, exactly 90 per cent of the imports in Africa originated in the continent to its North.

The imports of the developing countries taken together (Table 21) are very similar to the composition of the production of the industrialized countries (Table 13, above). The only exception is the category of shapes (rods, bars and sections). The imports by developing countries of this category are rather limited. However, for Africa and Latin America the patterns vary widely from the average. In Africa a large part of the imports consists of wire and for Latin America the opposite is the case.

---

1) The reader is once more reminded that not all imports are being taken into account, because, apart from South Korea and Taiwan, exports of other developing countries have not been recorded in the statistics that are being used here

TABLE 21

Composition of the imports of copper semis of the developing countries, 1981 (percentage shares)

	Lat. America	Asia	Africa	Developing C.
Wire	36	53	61	51
Shapes (rods, etc.)	22	13	11	14
Plates, etc.	16	23	20	22
Tubes	26	11	8	13
Total	100	100	100	100

Source: IWCC, World Trade in Copper and Copper Alloy semi-manufactures 1981

IV.3 The exports of the developing countries

The share of the developing countries in the world copper semis exports is very small and this is particularly the case for the copper producing developing countries. Notwithstanding these facts, three questions are relevant in the context of this study. First: are the exports of developing countries (almost) exclusively going to other developing countries or also to industrialized countries ? Secondly: to what extent are the semis sectors in the copper producing developing countries oriented towards exports ? And thirdly: is there or is there not an upward trend to be found in the exports originating in the copper producing developing countries ?

The exports of copper semis by the developing countries are estimated to have amounted to 185 million dollars in 1981 [1]. Based on an average unit value for world exports of US $ 2,300, this would be equivalent to 80,000 tons [2]. However, it is very likely that the unit value of exports from developing countries is lower than the

---

1) The most recent year for which fairly complete data are available from the Yearbook of International Trade Statistics; export values for Taiwan were estimated

2) The unit value is based on the value of world exports and an estimated volume of world exports of 1.7 million tons

world average, because these countries probably export mostly rather simple products. Taking this factor into account it is estimated that the exports from the developing countries were in the order of magnitude of around 100,000 tons in 1981.

The share of Africa in the exports of the developing countries is very small, less than 2% in 1981. The remainder is about equally shared by developing Asia and Latin America, each accounting for almost 50% of the exports of the developing countries.

The African exports are presently still small, but they have increased considerably since 1981. This is mainly due to the fact that Zambia has become an exporter of CCR [1]. In 1983 an Outokumpu installation with an initial capacity of 6,000 tons, started production. In 1984 production reached a level of about 5,000 tons. Given the limited domestic market, the wire rod production is necessarily export-oriented; almost 70 per cent (3,500 tons) was being exported. These exports went exclusively to other developing countries: India (2,500 tons), Kenya (300 tons), and Malaysia, Pakistan, Egypt and Tanzania (together 700 tons). It seems quite likely that the Zambian production and export of continuous cast wire rod will increase further in the years to come.

Taiwan and South Korea, exporting more than 26,000 tons in 1981, are (apart from Japan) the major exporting countries in Asia. Their production is not export-oriented; approximately 10 per cent of production is exported. The exports to Western Europe are almost zero. Limited amounts are being exported to the USA and Japan. More than 10 per cent of the exports goes to Australia. However, the major destination of the exports of South Korea and Taiwan is the countries of South East Asia.

Of the copper producers in South East Asia (the Philippines, Indonesia, and Papua New Guinea) only the Philippines has a refinery capacity since 1983. The output of this refinery could possibly become

---

1) Vingerhoets and Sannen, op.cit., 1985

the basis for an export-oriented copper semis industry. This could particularly be successful in case production could be geared to the regional market in the framework of an Asean-arrangement [1].

The exporting countries of importance in Latin America, are Chile, Peru, Mexico and Brazil. Chile is the only one of the four countries that exports copper semis for many years already. In 1970 the exports amounted to almost 10,000 tons [2]. In the following years they expanded rapidly and reached a level of over 30,000 tons in 1976 and 1977. In 1978 the exports declined by 40%, but in 1980 (the most recent year for which data on exports are available) they again amounted to 25,000 tons. The production of copper semis in Chile declined by about 50 per cent between 1979 and 1983. Consequently, exports also must have declined, particularly in 1983.

The Chilean copper semis production is quite heavily oriented towards exports. In the last four years for which data are available, exports averaged almost 60% of refined consumption [3]. It has been reported that around 1970 the Chilean exports went "principally towards other Latin American countries" [4]. In 1978 the situation was somewhat different [5]. In that year 45% of the exports went to the developed market economies, of which more than half to the USA and 30% to Europe. The remaining 55% of the exports went to other developing countries, mainly in Latin America. The two major importers of Chilean semis in the region are Colombia and Venezuela, together absorbing (in 1978) almost 75% of the Chilean exports to developing countries. In a second echelon come Ecuador, Uruguay and the Dominican Republic.

Since 1978 the Latin American countries seem to have regained their earlier relative position as importers of semis from Chile. In 1982 the value of the US imports from Chile had declined to less than 20

---

1) Perlman, op.cit., 1982, in Metall, p. 81
2) Yearbook of International Trade Statistics, Country tables
3) However, this percentage varied between 36% and 74%
4) Gueronik, op.cit., 1974, in Metal Bulletin Monthly, p. 44
5) 1978 is the only year for which data on the destination of Chilean semis exports can be derived from the UN Commodity Trade Statistics

per cent of the value in 1978. Besides, the Chilean attempts in the second half of the seventies to penetrate the market of the EEC, seem not to have succeeded. In 1980 the imports of the EEC from Chile still exceeded 3,000 tons; in 1983 they had dropped to exactly 700 tons [1]. Since Chile had been the only developing country exporter to the EEC of any importance, the imports of the EEC from the developing countries had again declined to a triffle.

Exports of copper semis from Peru seem only to have started in 1971. They expanded rapidly and reached a level of almost 12,000 tons in 1978. Exports peaked in 1979 at 16,500 tons. In the next year the exports almost halved to less than 9,000 tons. In 1982 they recovered and reached almost 12,000 tons, the level of 1978. In the period 1980/1982 the exports averaged 50 per cent of refined consumption. So, the production is quite heavily oriented towards exports.

The peak in Peruvian copper semis exports in 1979 is almost completely due to a sudden substantial increase of exports to the USA. In 1978 only 7% of the total exports (in value terms) went to the USA; in 1979 almost 40% and in 1980 the figure dropped to 25%. In 1980 about 75% of the Peruvian exports went to the regional Latin American market. Colombia, Ecuador, Uruguay, Costa Rica and El Salvador were the major countries of destination.

Since 1980, however, the USA seems to have become an important market for Peruvian copper semis on a more permanent basis. According to US import data and total Peruvian export figures (in value terms) the USA accounted for about 70 per cent of total exports from Peru in both 1981 and 1982 [2]. It is not unlikely that this situation is going to be continued in the years ahead. Recently a new brass mill was opened in Peru [3]. The capacity of the mill is small: about 5,000 tons per year. It is interesting to note, however, that 70 to 75 per cent of the production is planned to be exported, mainly to the USA.

---

1) Derived from Eurostat, analytical tables of foreign trade, EEC, Brussels, several issues
2) Source: the UN Commodity Trade Statistics
3) American Metal Market, June 27, 1985

Brazil and Mexico are by far the largest producers of copper semis in Latin America. Before Brazil's production plummeted in the depression of 1983, its refined consumption reached a peak of 250,000 tons in 1982. Refined consumption in Mexico peaked in 1981 at a level of 130,000 tons. The rapid expansion of production in these countries during the seventies has completely been based on domestic demand (compare Chapter III).Exports of copper semis have been very limited, particularly when related to total production. Brazilian exports amounted to only 3,000 tons in 1980. In the same year, Mexico exported only 5,000 tons and, importing a larger amount, net imports were about 8,000 tons.

In 1981 imports of brass mill products in the USA reached a new level of 200,000 tons, 15% of apparent consumption [1]. The upsurge in these imports is being linked with the structural changes in the copper industry: the concentration on specialty products by a number of brass mills, apparently leaving part of the "bread-and-butter products" to companies in foreign countries.

In the context of the present study it is interesting to note that Brazil and Mexico have managed to capture a share of over 10 per cent of these US imports, exporting respectively almost 11,000 and 8,000 tons to the USA in 1983. The Brazilian and Mexican exports are connected with the export drive of these countries against the background of their debt problems and with an enormous overcapacity due to depressed domestic markets. Are these exports going to get a more permanent character ? Particularly in the case of Mexico this could be possible, if the country maintains its export orientation and if the production of refined copper is being expanded. However, an even more important question is whether Peru and Chile could follow Mexico and Brazil in this respect. There are indications that Peru is already heading into that direction. This is not surprising, because with proper economic policies stimulating an outward-orientation of their

---

1) Copper Studies, August 1984, p. 3

manufacturing industries, there seem not many reasons why Chile and Peru could not participate in the increased imports in the USA. After all, these countries do have the advantage of local availability of refined copper [1].

Trade barriers

Exports of developing countries encounter the same trade barriers in other developing countries as the exports originating in the industrialized countries. The situation is also identical with respect to non-tariff barriers in the industrialized countries. The situation is different, however, as regards tariffs on imports in the industrialized countries. The copper semis exports from developing countries are in all major industrialized countries eligible for duty-free importation under the Generalized System of Preferences (GSP). On this ground, it is tempting to conclude that "the effect of tariff barriers on the location of the further stages of copper processing and on the composition of exports from each copper-exporting developing country is minimal" [2]. However, this conclusion seems to be based on a very superficial look at the application of the GSP-system. In Japan, the EEC and the USA, duty-free imports under the GSP are, in almost all cases, being limited by ceilings [3]. In Japan these ceilings on imports of individual developing countries are very low. In the USA a country is no longer entitled to GSP treatment for a certain product when imports into the USA from that country exceed a certain amount (the "competitive need limitation"). This amount is defined as more than 50 per cent of all developing countries' exports of a certain product to the USA, or as a value which varies with the US GNP. This value was set at $ 50.9 million in 1981 [4]. In the EEC

---

1) This point will be elaborated upon in Chapter V, below
2) Kirthisingha, op.cit., 1982, p. 299
3) Data mainly derived from UNCTAD, op.cit., 1982, p. 60-64
4) OECD: "The Generalized System of Preferences; review of the first decade", Paris, 1983, p. 34

both Plates, etc. and Tubes have been placed on the so called sensitive list of the GSP, meaning that preferential imports of individual exporting countries are being limited and that limits apply for exports to each individual EEC member country. Special and more restricted limits have been imposed on imports from Chile and Brazil. Besides, the composition of the "sensitive list" can change from year to year.

Because of the system of ceilings in the GSP it is always highly uncertain how much can be exported duty-free to a certain market. When an investment decision has to be made in a developing country, it can never be counted upon that a certain (substantial) amount could be exported under a GSP-regime. And this does not only apply when ceilings have already been imposed explicitly. The case of CCR and the EEC may serve as an example. Given the very high protection in the EEC and the usual application of the GSP, for Chile the local production of wire rod and export to the EEC was no real alternative to participation in production within the EEC. In case exports from Chile to the EEC would have reached a certain amount, restrictive ceilings would most probably have been imposed, limiting the exports to the EEC.

It is tentatively concluded (but a more detailed analysis is in order) that exports of copper semis from the developing countries to the major industrialized countries are being limited by the system of import tariffs, including ceilings in the framework of the GSP.

CHAPTER V

The viability of export-oriented copper fabrication in copper producing developing countries

Based on the foregoing chapters, we now face the question of the viability of export-oriented copper fabrication in copper producing developing countries. The arguments and counterarguments that have been analysed in previous chapters, are systematically being brought together. Besides, a few additional factors are being dealt with. The initiation or expansion of export-oriented copper fabrication is only viable in case this is both desirable and feasible in the economic context of the countries concerned.

V.1 The desirability of export-oriented copper fabrication

The general question to be addressed is whether export-oriented fabrication of copper(alloy) semis could fit into an industrialization strategy of copper producing countries, while specific questions are related to the contribution of such an export-oriented sector to income, employment, etc..

At the general level we touch upon the merits of a resource based industrialization (RBI)-strategy. Despite very limited research on RBI-strategies, it is clear that RBI could be the sole industrialization strategy in only a very limited number of developing countries. In most countries "import substitution and development of labor-intensive manufactures for export are likely to be integral components of their industrialization strategies" [1]. However, typical mineral-exporting/copper-exporting countries have neither been very successful in import substitution nor in labor-intensive manufacturing. Import-substituting manufacturing has more often than not been

---

1) Nankani, G.: "Development problems of Mineral-Exporting countries", World Bank Staff Working Paper, No. 354, August 1979, p. 19

a high cost sector, stagnating after the easy phase of substitution was over. On the other hand, it is hard to imagine that mineral exporting countries - with relatively high wages in the formal sector, due to the wage leadership of the mining sector - could break into the world market for labor-intensive manufactures.

Neither import substitution nor labor-intensive exports seem to offer a viable industrialization strategy for the mineral exporting developing countries, including the copper countries. A promising alternative has recently been advocated by Irma Adelma: agricultural-demand-led industrialization (ADLI) [1]. The essential features of such a strategy are a public investment programme in agriculture and neutrality in policy with respect to export promotion or import substitution. The activities of the manufacturing sector would primarily be based on linkages with the agricultural sector: production of inputs and processing of agricultural raw materials. Extending this model to the mining sector, there would be a similar role for the manufacturing sector as with respect to agriculture: production of inputs for the mining sector and processing of raw materials.

In many cases the processing of locally available resources for domestic consumption will have to be combined with exports because of the required minimum scale of production. Local processing of raw materials seems to offer the best opportunities for many a mineral-exporting country to start or expand exports of manufactured products. The countries concerned are generally not well suited to export labor-intensive products. In efforts to turn import substitutes into exports, there are no particular advantages over other countries. In the processing of raw materials the availability of cheap raw materials of good quality should be combined with efficient processing. Most of the processes involved, and this also holds true for copper and copper alloy semis, are not particularly labor intensive and they may require the development of specialized skills.

---

1) Adelman, I.: "Beyond Export-Led-Growth" in World Development, Vol. 12, No. 9. 1984

Apart from the direct positive effects of a processing industry on employment and income, the contribution of such an industry to development could be twofold: be one of the spaerheads in the build up of an internationally competitive manufacturing sector and, secondly, to save and earn foreign exchange, to be used particularly for agricultural development.

Addressing the question of the desirability of export-oriented fabrication at the specific level, we deal successively with capital intensity and employment, income, linkages with other sectors of the economy and finally with foreign exchange earnings.

Capital intensity and employment

One of the major hesitations regarding the desirability of copper fabrication in a developing country usually is the rather capital-intensive nature of the production processes. Two factors are relevant in this respect: the capital-intensity compared with earlier production stages in the sector and the sources of investment capital.
As was noted earlier in Chapter III, fabrication of copper (alloy) semis is, measured in terms of the capital/output ratio, less capital-intensive than the earlier stages in the copper sector. In mining the capital/output ratio is in the order of magnitude of 5 to 6, in smelting the comparable figure is in the order of 6 to 8, in refining 2 to 3 and in CCR-production about 1 to 1,5 [1]. In brass mills the variation of capital-intensity can be quite wide, depending on the product mix, but in several cases the capital/output ratio seems even to be smaller than in CCR-production. It is concluded that, from the point of the capital/output ratio, fabrication of semis is more suitable for developing countries than mining, smelting or refining of copper.
Another, but similar, argument against copper fabrication in developing countries could be that the capital/labor ratio is relatively

---

1) Based on large scale production; with production at a smaller scale, the capital/output ratio can easily increase to a value of 2 or even 2.5

high. It is simply a fact that the whole copper sector, including production of semis, does not create much employment. In CCR-production, for example, the investment costs per person employed are about $ 150,000. However, in both mining and smelting the investments per employee are even higher. In mining the capital/labor ratio is estimated to be 3 to 4 times as high as in CCR, and in smelting the ratio is 2 to 3 times as high. In refining and CCR-production the capital/labor ratios seem to be of the same order of magnitude. Despite the fact that fabrication of copper (alloy) semis is less capital-intensive than the earlier stages of the copper sector, production of semis can never contribute substantially to a solution of the employment problem in a developing country. Assuming that the estimates given above are about correct, that the capital/labor ratio in brass mills is on average about the same as in CCR-production and that processing is equally divided between CCR and brass mills, it turns out that processing of 100,000 tons refined copper would create employment for less than 500 persons [1]. Even if, connected with low wages, labor intensity could be doubled, the copper semis sector still would only contribute marginally to employment creation in the countries concerned.

In developing countries, investments in sectors creating little or very little employment, can only be justified under certain conditions. One justification for a capital-intensive investment can be that for that purpose, and not for alternative ones, capital can be raised from abroad. When a feasible investment opportunity in fabrication of copper (alloy) semis exists, additional funds could be raised abroad (either direct investments or loan capital). Given the high capital-intensity in the copper sector (including fabrication of semis), it seems imperative that a substantial part of investments in this sector is financed by capital imported from abroad. In that

---

1) 100,000 tons is almost 20% of the refined production in Zambia and almost 50% of the production in Peru

case the capital-intensity is irrelevant, because those funds can not be used for alternative investments. The national economic gains derived from these investments are sort of a "windfall profit" for the country.

Income

Production of copper (alloy) semis in copper exporting countries is first of all desirable because income can be derived from such activities: wages, profits, government income. Wages generate demand for consumer goods originating in agriculture and other industrial sectors. Profits will, with external financing of investments, at least partly be repatriated. The government tax-base could be broadened and consequently the development expenditures of the government could be increased.
When processing only a part of the refined production and fabricating relatively simple semis, the economic situation of a copper exporting country could never be improved dramatically. However, with processing of, for instance, 20% of the refined production and with wages, profits (capital income) and taxes at a level of 25% of the value of refined copper, the income derived from this sector would increase substantially [1].

Linkages

It is tempting to be optimistic on the linkage effects of local production of copper (alloy) semis. One should be careful, however, and distinguish clearly specific linkages and general ones [2]. Backward linkages will be negligible or non-existent. Forward linkages due to the availability of locally produced semis, will only be at work in case semis become available at lower prices than in the

---

1) The relative increase depends on the share of wages, profits and taxes in the value of refined copper
2) A warning to be careful can, for instance, be derived from Zorn, op.cit., 1985, p. 39-40

case of imports. For a landlocked country like Zambia, such a linkage effect could have a positive impact on the production of finished products like electric motors, generators and transformers; nuts, bolts, taps, valves; lampfittings and electrical apparatus. In countries like Peru or Chile, where transport costs weight much less heavily on imports, a forward linkage effect due to lower prices, is likely to be (much) smaller.
At a general level, the establishment of a copper (alloy) semis industry could of course have a positive effect on the pace and pattern of industrialization: industrial experience can be gained, skills developed, etc.. Such effects could, however, also be derived from the establishment of other industrial sectors. Generalizations are therefore meaningless. In each country the alternatives will have to be studied carefully.

Foreign exchange earnings

With local production of copper semis, foreign exchange is being earned or saved. With an avarage value added of 25% (an assumed average for CCR and brass mill products) gross additional export earnings could be substantial. When processing, for instance, 40% of the raw material production, gross export earnings could be increased by 10%. This is not a panacae for the balance of payments problems of the countries concerned, but it could mean a significant improvement of the situation.
Exports of copper semis instead of raw (refined) copper, also would mean a diversification. The product diversification is within the copper sector. The country is not diversifying away from the ups and downs in demand for copper products. However, it seems that the relative price fluctuations for refined copper are wider than in the case of copper semis. The price for the value added in fabrication is comparatively constant. This means an advantage in case of fabrication and export of semis: the export proceeds from the copper sector would be less volatile.

A diversification with respect to markets would materialize when exports of semis to other developing countries would replace exports of refined copper to OECD-countries. Since developing countries are the most dynamic copper consumers and because countries like Zambia and Peru have the greatest competitive advantage when exporting to nearby developing countries, such a diversification is most likely. It would make the copper countries less dependent on the markets in the industrialized countries.

V.2 The feasibility of export-oriented copper fabrication

It is not the intention of this study to establish definitely the feasibility of the production of certain copper (alloy) semis in certain copper countries. That would require detailed studies in the countries concerned. The objective is rather to get a clear idea of the possible feasibility and of the factors that are of critical importance.

V.2.1 The Technical Factors

1. The products and the inputs

One of the arguments against export-oriented production of brass mill semis in the copper countries is that "the products themselves, after the first stage of rod/sheet/tube manufacture, become highly specialized and often made to consumer specifications" [1]. This argument does not seem to be valid (any more). Admittedly, brass mills produce a wide variety of products. However - as is, by the way, hidden but implicit in the quotation cited above - most products are, or are based on, standard products. Recent developments in the industry accentuate the distinction between standard products and specialty products. Some companies concentrate completely on specialties, while others produce only standard products. Our best

---

1) Copper Studies, October 3, 1975, p. 5

estimate would be that about 90 per cent of all brass mill products are, at least initially, standard products.
Rejections by users of copper semis and new scrap originating in the further processing of semis, are usually returned to the semis fabricator. In the case of overseas exports this would be very costly. This situation is being used as an argument against processing in copper exporting developing countries. Linked with this question of new scrap, is the availability and price of old scrap: "The lower cost of scrap vis-a-vis primary refined copper gives a competitive advantage to those plants, located in industrialized areas, that have access to a scrap feed" [1].
It is strange that there is a discrepancy between the price of virgin copper and scrap. One would expect that the price for the same material is the same, independent of its origin. It is a fact that scrap can not be used for all purposes. For production of CCR, for instance, high quality primary refined cathodes are required. This being the case, one would, however, still expect that the price of primary refined is equal to scrap for use in that part of the market where either one can serve as an input. With an only marginally lower price for scrap, no primary metal would be used. Only artificial trade barriers can explain a discrepancy between scrap and virgin metal. In the EEC, for instance, there are export quota for copper scrap to stimulate recycling and to reduce import dependence [2].
Consequently, the alleged disadvantage of fabrication in developing countries is <u>not</u> due to technical factors but caused by institutional arrangements. With removal of this artificial trade barrier, this disadvantage of location of brass mills in developing countries would most likely disappear [3].

---

1) Copper Studies, October 3, 1975, p. 5
2) Vingerhoets, J.: "Ontwikkelingslanden als Grondstoffenexporteurs", 1982, p. 360
3) Only in case the scrap supply surpasses the demand for purposes where both materials can be used, the scrap price would be lower

On the other hand, copper producing developing countries do have the advantage of a secured supply of feedstocks for semis production. This does not only pertain to copper, but also to brass, because most copper producing countries, e.g. Zambia and Peru, also have zinc mines.

2. The processes

The processes for the standard products (CCR, sheet, tubes, shapes) are also standard ones and freely available. One can buy the equipment from and have it installed by the fabricators of the machinery. Of course, adequate metallurgical and mechanical skills are needed to operate and maintain the equipment properly. Because of the existence of the mining sector and a related machinery industry, these skills are usually relatively well developed in the copper exporting countries.

Recent developments in continuous casting could be advantageous for copper producing developing countries. Continuous casting and rolling of rectangular sections and strips seems to become feasible [1]. There is no reason why these productions should only be attached to refineries in the industrialized countries. Like in the case of CCR, the attachment to refineries in the developing countries merits at least detailed investigation.

Our knowledge regarding economies of scale in the production of copper semis is limited. Further investigations are required to establish for different production lines the disadvantages (costs) of production at a small scale and how, at what speed, these disadvantages disappear when the scale of production is being enlarged. Serious diseconomies of scale must be avoided. It seems that this does not require a very large scale of production, since countries like Chile, Zambia and Peru, producing at limited scales, have succeeded in exporting certain amounts of copper (alloy) semis.

In the literature no mention is made of the advantage of low wage

---

1) Copper '83, op.cit., 1983, p. 3.8 and 3.10

levels in developing countries. The production of copper (alloy) semis is rather capital intensive, but this does not mean that the advantage of low wages is by definition negligible. In the production of CCR in the industrialized countries, for instance, the share of wage costs is estimated at about 20 per cent of total costs. When wages in a developing country are 25 per cent of the wages in an industrialized country, this would imply a potential reduction of total costs of 15 per cent. Such a potential cost saving will certainly be reduced by a lower level of labor efficiency. Labor efficiency will vary from country to country and from sector to sector. Detailed research is needed to be able to estimate the likely (or actual) labor efficiency in copper (alloy) semis production in individual developing countries. An advantage in semis production is that the process is machine-paced. In such processes relative labor efficiency is usually higher than in labor-paced processes. When in the example given above, relative labor efficiency would be 50%, the savings on labor costs would be reduced to 10% of the total costs. This is not enormous, but not negligible either.

3. Transport costs

A standard argument against export-oriented production of copper (alloy) semis in the copper countries is that the transport costs are higher than for cathodes [1]. As a "proof" for the validity of this argument, reference is made to the fact that the volume of international trade would be limited and largely confined to intra-regional trade. In the foregoing chapter we have shown already that this "proof" is no longer valid: in recent years international trade in copper (alloy) semis, including long-distance trade has increased at a rapid rate.

However, the fact remains that transport costs are higher for copper semis than for cathodes. Freight rates don't necessarily have to be higher, because in both cases we are dealing with "close weight car-

---

1) Copper Studies, December 16, 1975, p. 4

go". The higher transport costs in the case of semis are (or: should be) due to packing, handling and insurance costs. The semis have to be packed to protect them against the influence of salt air. These costs should, however, not be exaggerated, as is sometimes being done in the literature. In Zambia, for instance, the CCR-coils are simply, but effectively, packed in plastic foil.

At present, we do not (yet) have data on freight, packing, handling and insurance costs of semis, adding up to the total transport costs from a number of origins to different destinations. These data will have to be collected in order to be able to assess the importance of transport costs for the location of semis production in the copper countries. What can be done at the moment, is to define exactly the problem at hand, taking into account a special feature of the price setting in the world copper market.

It is customary in the world copper market, that buyers pay a price independent of the costs of transport from the mine/refinery to the fabricator. The prices for refined copper are based on the quotations on the London Metal Exchange (LME). A buyer pays that price and the transport costs are being paid for by the primary producer. For a fabricator, there is no advantage in buying from a nearby mine/refinery, and for a mine/refinery it is very costly when the product has to be transported over a long distance.

With local production of copper semis in a copper mining country, one saves the costs of transporting the refined metal. It is therefore justified to give a discount to a local fabricator equal to the saving on transport costs. It is impossible to determine these savings on a case-by-case basis. The best solution seems to be to give a discount equal to the average costs of transporting the refined metal. In Zambia, for instance, such a discount system is in operation [1]. As an average for transport costs, one has taken the costs of transporting cathodes to Western Europe.

---

1) This situation prevailed at the end of 1984

Depending on the location of the buyer of semis and the location of potential competitors, the discount for savings on transport costs of refined will be of greater or smaller importance for a fabricator in a copper producing developing country. To get a better idea of the importance of this factor we discuss, only as an example, briefly three cases of (partly imaginary) exports of copper semis from Zambia.

Case one. When a Zambian fabricator would try to export copper semis to Western Europe, he has to pay for the higher transport costs of semis. This is a disadvantage vis-a-vis the fabricators that produce semis within Western Europe.

Case two. When exporting to a regional market, for instance Kenya, the advantage for the Zambian fabricator depends on the location of the competitor. In case the fabricator would have to compete with a competitor from Western Europe, the situation is as follows. The Zambian fabricator gets the discount, but he has to incur the costs of transporting the semis to Kenya. These costs are most probably lower than the discount for the saving of the transport costs of refined. The Western European fabricator, on the other hand, pays the full LME-price and he also has to pay for the transport of the semis to Kenya. The advantage for the Zambian fabricator is substantial.

In case the competitor would be located in Kenya, the advantage for the Zambian fabricator would, of course, be smaller. However, the costs of transporting semis to Kenya are most likely to be lower than the discount on the LME-price. The Zambian fabricator enjoys a cost advantage over a Kenyan competitor.

Case three. When producing for the local Zambian market, the cost advantage for the local fabricator is very substantial: the discount on the LME-price plus the costs that competitors have to bear for transporting semis to landlocked Zambia.

4. Conclusion

Considering the technical factors, there appear to be two positive and two negative factors of importance with respect to local processing of copper. The positive factors are relatively low wages in comparison to the industrialized countries and savings on transport costs when producing for the local and regional market. The possible negative factors are diseconomies of scale and relatively low labor efficiency. At a scale of production of any substance, the advantages could easily outweight the disadvantages. Our preliminary conclusion is that, based on the technical factors, one would expect export-oriented processing in the copper countries to be (much) further developed than is actually the case. Negative institutional factors have probably been at work.

V.2.2 Institutional factors

1. The structure of the sector

The existence of excess capacity in the industrialized countries is sometimes being used as an argument against (expansion of) semis production in developing countries [1]. This phenomenon is related to the stagnation of demand in the industrialized countries, technological developments (CCR) and the structure of the sector (oligopolists competing for market shares). This factor is not likely to hamper structurally nor severely export-oriented production in developing countries, because the excess capacity is likely to be of a temporary nature and because the most rapid expansion of demand is taking place in developing countries.
The structure of the semis sector in the OECD-countries limits the feasibility of export-oriented processing in the copper countries. In the brass mill sector, concentration is quite high and most of the leading companies are integrated backward with refining. In the

---

1) Copper Studies, December 4, 1975, p. 4

wire and cable sector, concentration and vertical (forward) integration are at an even higher level. Concentration and integration limit access to a sector for newcomers. Forward integration directly limits the "free" market and integration always discourages relocation of part of the production chain.

For a "newcomer" from a developing country, it would be very difficult to break into the oligopolistic market in North America, Western Europe or in Japan, on its own strength. Besides, also when trying to export to other developing countries, strong competitors are to be encountered. Marketing will therefore be a crucial issue. Of course, in the long run these problems could be eased by measures like stricter anti-trust laws in OECD-countries and better international regulation against dumping. In the meantime, however, it seems more or less necessary to join forces with a Western company. Making use of the marketing experience, the customer relations and the marketing network of a recognized Western fabricator would be the best way to solve the marketing problem. Otherwise it would be very costly and very difficult to build up an effective marketing network.

For a Western fabricator, a joint venture with a fabricator in a developing country could mean a (partial and relative) relocation of production. However, there have never been strong incentives for Western copper fabricators to relocate (part of) the production process to developing countries. The technical factors have apparently (like in the case of copper refining) never been of overriding importance and other institutional factors (see below) have discouraged relocation of production to copper producing developing countries. A joint venture will have to be (made) attractive for a Western company. The general investment climate in a developing country and specific (temporary) incentives are of importance. Besides, it seems that the trade policies of both importing and exporting countries are highly relevant.

2. Trade barriers in importing countries

The conclusion reached by Kirthisingha, that the effect of tariff barriers on the composition of exports from copper countries "is minimal" [1], is certainly wrong. Only a review of the literature on trade barriers already shows that they limit the feasibility of export-oriented processing.

In the industrial countries the most significant non-tariff barrier consists of technical and quality specifications which may be changed over time. With respect to tariffs, the functioning of the Generalized System of Preferences is of importance. In the major OECD-markets, ceilings and tariff quotas limit the amounts that can be imported with preferential treatment. Besides, the extent of preferential treatment can be changed overnight. The uncertainty inherent in the GSP means that a potential investor can never be sure of preferential treatment. It has happened too often that preferences are no longer granted when an exporting country succeeds in exporting only a limited amount to an OECD-market. Consequently the most-favoured-nation tariffs seem to be more important than the GSP-margins. The general tariff protection is higher in the EEC and Japan than in the USA. In the first two markets mentioned they prohibit or severely limit imports from developing countries and other OECD-countries.

In developing countries that have been practicing import-substitution, the situation with respect to trade barriers is similar to the situation in the industrialized countries. The local industry is sometimes heavily protected against imports by tariffs and non-tariff barriers, like quotas and import licencing. In the absence of a preferential system for other developing countries, the (potential) imports from industrialized and developing countries are affected alike.

It is concluded that trade barriers in both industrialized countries and a number of developing countries, are an institutional factor

---

1) Kirthisingha, op.cit., 1982, p. 299

limiting the viability of semis fabrication in copper producing developing countries. However, more research is needed to establish firmly the significance of this factor in the various markets.

3. Trade policies of copper exporting developing countries

It has been observed "that the commercial policies of developing countries restrict their exports of processed goods" [1]. Import-substitution policies typically imply an anti-export bias. Locally purchased inputs become expensive. Import-substitution many times goes together with overvalued currencies (exchange rates), thus reducing the real proceeds from exports.

These general observations also seem to be applicable to copper exporting countries. Countries like Peru, Chile and Zambia have followed import-substitution industrialization policies during all or most of the past decades. Besides, in times of favourable demand and prices for copper, devaluation could, without damaging effects for the balance of payments, lag behind inflation. Prices of imports could be kept relatively low. However, this severely limited the possibilities to export manufactured products.

It is a simple fact, that an anti-export bias of the trade policy of a country is not compatible with the objective of exporting manufactured products, including processed raw materials. A neutral trade policy, as defined above, is the minimum requirement. It has not been investigated in the framework of this study, to what extent the policies of the countries concerned have changed in recent years. However, it seems that recent general adjustment policies have diminished the inward-orientation of several copper exporting countries. The need for further adjustment, particularly for devaluation (depreciation) has to be considered on a country-by-country basis.

---

1) Wall, D.: "Industrial processing of natural resources", in World Development, Vol. 8, 1980, p. 309

V.3 Conclusions

In conclusions regarding the viability of export-oriented semis fabrication in copper countries, a distinction can be made between substantive conclusions and identified further research requirements.

The desirability of copper fabrication can in the first place be established in terms of an ADLI-strategy in which processing of agricultural and mineral raw materials, rather than export-oriented production of labor-intensive manufactures, is part and parcel of the industrialization strategy. Specific advantages of fabrication of copper semis are: the relatively limited capital-intensity within the copper sector; the generation of wages, profits and taxes; possible forward linkages and, last but not least, increased foreign exchange earnings.

As regards the feasibility of semis fabrication, the balance of positive and negative technical factors is, under certain conditions, likely to be in favour of a copper exporting country. Particularly when producing for local and regional markets, the savings on transport costs can be significant. Low wages can be an advantage when contemplating exports to industrialized countries. On the other hand, diseconomies of scale can be at work. Besides, relative labor efficiency is probably very important and may even be a decisive factor.

Turning to the institutional factors, the best way to overcome the problem of the oligopolistic nature of the structure of the sector in the market economies, seems to be to join forces with an established fabricator from an industrialized country. Secondly, trade barriers in both industrialized and developing countries limit the viability of export-oriented copper processing. Finally, the trade policy of the potential exporting country itself must not be a barrier to exports of copper (alloy) semis.

In future research on the feasibility of export-oriented semis production in the copper countries, priority should be given to four technical factors and two institutional ones. The technical factors

are: labor efficiency in local processing, economies of scale, transport costs, and (forward) linkage effects. The institutional factors are: trade barriers in both industrialized and developing countries and the trade policies of potential exporting developing countries.

JV/JL
11-85341

GENERAL ANNEX

TABLE I

Major Western World Copper Mine Producers, 1977

Rank	Producer's Nationality	Countries where mined	Producer	Share of total West. world mine production		Share of privately owned West. world mine production	
				(%)	(Cum. %)	(%)	(Cum. %)
1	Chile	Chile	Chilean State	16.8	16.8		
2	Zambia	Zambia	Zambian State	10.8	27.6		
3	Zaïre	Zaïre	Zaïrois State	7.5	35.1		
4	Britain	Canada/S.Afr./ Spain/N.Guinea	Rio Tinto Zinc	6.8	41.9	10.5	10.5
5	USA	USA/Australia/ Peru/Mex./Nicar.	Asarco	6.0	47.9	9.2	19.7
6	USA	USA	Kennecott Copper	5.4	53.3	8.3	28.0
7	Japan	Canada/Peru/ Philipp.	Consortium: Dowa,Furu-kawa,Mitsubishi,Mitsui, Nippon, Sumitomo	5.1	58.4	7.9	35.9
8	USA	USA	Phelps-Dodge	4.9	63.3	7.5	43.4
9	USA	Canada/S.Afr./ USA	Newmont Mining	3.7	67.0	5.7	49.1
10	USA	Canada(USA	Anaconda	3.4	70.4	5.2	54.3
11	Canada	Canada	INCO	2.4	72.8	3.7	58.0
12	S. Africa	Canada/Namibia/ S.Afr./Zimbabwe	Anglo-American Group	2.1	74.9	3.2	61.2
13	USA	USA	Duval Copper div. Pennzoil	1.9	76.8	2.9	64.1

TABLE II

Major Western World Primary Refined Copper Producers, 1977 (Asterisk designates custom refiners)

Rank	Countries	Producer (home country)	Share of Western world refinery capacity (%)	(Cum. %)
1	USA, Australia	Asarco (USA)	9.8	9.8
2	Zambia	Zambian State (Zambia)	9.1	18.9
3	Chile	Chilean State (Chile)	7.9	26.8
4	USA, Canada	Kennecott Copper (USA)	6.1	32.9
5	USA	Phelps-Dodge (USA)	5.8	38.7
6	Canada	Noranda Mines (Canada)	5.2	43.9
7	Several	Nippon Mining *) (Japan)	4.3	48.2
8	Belgium	Metallurgie Hoboken-Overpelt *) (Belgium)	3.9	52.1
9	Several	AMAX *) (USA)	3.3	55.4
10	Zaïre	Zaïros State (Zaïre)	3.0	58.4
11	Several	Rio Tinto-Zinc (Britain)	2.9	61.3
12	W.Germany	Nordeutsche Affinerie*) (W. Germany)	2.8	64.1
13	Japan	Onahana Smelting & Refining *) (Japan)	2.8	66.9
14	USA, Canada	Anaconda (USA)	2.7	69.6
15	Peru	Peruvian State (Peru)	2.3	71.9
16	Canada	INCO (Canada)	2.3	74.2
17	Several	Newmont Mining*) (USA)	2.1	76.3
18	Several	Sumitomo Metal Mining*) (Japan)	2.1	78.4
19	Several	Mitsubishi Metal Mining*) (Japan)	1.9	80.3
20)	Yugoslavia	Rudarsko Topionicarski Basen, Bor *) (Yugosl.)	1.8	82.1

Source Tables I and II: Becker, D.: "The new bourgeoisie and the limits to dependency: mining, class and power in 'Revolutionary' Peru", Princeton University Press, Princeton, New Yersey, 1983

TABLE III The major copper fabricators

Rank Order	Producing unit	Country	Capacity (1000MT)	Share of total indentified capacity (%)
1	British Insulated Callender's Cables, Ltd.	UK	475	6.1
2)	Anaconda Company	USA	362	4.6
3	Drawn Metal Tube Co.	USA	315	4.0
4	Sumitomo Metal Mining	Japan	295	3.8
5	Pirelli Intern. SA	Italy	250	3.2
6	Furukawa Electric	Japan	240	3.1
7	Delta Metal	UK	234	3.0
8	MIM	UK	190	2.4
9	Hitachi	Japan	187	2.4
10	IMI	UK	180	2.3
11	PUK	UK	164	2.1
12	AT and T (West Elec. Co. Inc.)	USA	150	1.9
13	Sté. Generale	Belgium	150	1.9
14	Mitsui Min.& Smelting	Japan	142	1.8
15	Mitsubishi Met.Mining	Japan	120	1.5
16	Noranda	Canada	117	1.5
17	Toshiba Denko	Japan	96	1.2
18	Gutehoffnungshütte AG	FR of Germ.	80	1.0
19	Metallgesellschaft AG	FR of Germ.	80	1.0
20	Sta.Metallurgica Italiana	Italy	80	1.0
21	Continental Copper & Steel Ind. Inc.	USA	80	1.0
22	Direccion General de Fabricaciones Milit.	Argentina	79	1.0
23	Sdad.Espanola de Construcciones Elec.Mecanicas SA	Spain	76	1.0
24	Diehl Metal Works	FR of Germ.	75	0.9
25	UV Industries Inc.	USA	67	0.9
	Other		3537	45.3
	Total Ident.Semi-fabricating Capacity		7821	100

Source: Metals Bulletin, special issue, 1974

STATISTICAL ANNEX

TABLE 1.1

World mine production (in 1000 MT)

Country		49/51	59/61	69/71	79/81	82	83
DME	Finland	17.3	30.3	30.8	38.7	38.2	37.7
	Norway	14.8	14.6	20.9	28.6	27.9	26.2
	Spain	17.3	17.8	24.2	49.3	58.1	63.9
	Sweden	15.6	17.7	27.2	46.4	55.4	64.0
	UK	-	-	-	0.3	0.6	0.7
	Yugosl.	39.3	35.3	89.0	113.1	119.3	129.5
	Other Europe[1]	7.3	16.4	19.0	9.1	5.6	5.5
	Total Europe[1]	111.6	132.1	211.1	285.5	305.1	327.5
	Canada	241.2	385.1	594.9	681.4	606.3	625.0
	USA	783.3	928.4	1447.4	1387.6	1139.8	1038.1
	N.America	1024.2	1313.5	2042.3	2069.0	1746.1	1663.3
	S. Africa	32.7	51.3	144.6	208.5	207.1	211.8
	Japan	38.4	90.3	120.5	54.4	51.0	46.0
	Austrilia	15.3	101.6	155.3	237.5	241.8	264.6
	Total	1225.0	1688.8	2673.8	2854.9	2551.1	2513.0
LDC	Namibia	11.1	25.8	24.7	41.8	48.8	52.1
	Uganda	-	13.4	16.7	-	-	-
	Zaïre	169.8	293.3	386.1	454.8	502.8	502.2
	Zambia	292.0	504.8	685.0	590.5	529.6	578.3
	Zimbabwe	-	-	-	26.2	24.8	23.7
	Other Afr.[2,3]	1.4	18.2	28.8	26.2	39.6	44.8
	Total Afr.[2]	474.3	915.5	1141.3	1139.5	1145.6	1201.1
	Chile	371.6	541.4	696.0	1070.6	1240.7	1257.1
	Mexico	62.1	55.6	63.5	171.0	239.1	206.1
	Peru	30.0	114.0	208.8	363.8	356.3	322.2
	Lat.Am.	488.5	759.1	987.4	1615.4	1863.5	1820.8
	India	7.0	8.6	10.3	26.8	24.0	43.8
	Indonesia	-	-	-	60.6	75.1	78.6
	Malaysia	-	-	-	26.6	30.9	28.5
	Philipp.	10.0	48.5	163.1	301.7	293.1	271.4
	Turkey	13.5	29.5	28.0	28.6	31.4	24.9
	Other Asia[1,3,4]	24.7	44.7	33.6	5.5	49.4	80.2
	Dev. Asia[1,4]	55.2	131.2	235.0	449.8	503.9	527.4
	Pap.N.Guin.	-	-	-	161.0	170.0	183.2
	Total	1015.2	1805.9	2363.7	3365.7	3683.0	3732.5
CPE	Bulgaria	-	12.1	40.4	61.3	70.0	80.0
	Mongolia	-	-	-	45.8	95.0	95.0
	Poland	1.4[6]	10.6	84.5	325.9	376.0	402.3
	USSR	224.0	496.7	930.0	1133.3	1180.0	1180.0
	China and oth.Asia	19.1	93.9	165.4	243.5	259.7	185.0
	Total	244.5	613.3	1220.8	1809.8	1980.7	2009.5
CIPEC[5]		863.4	1543.5	1975.9	2701.3	2874.5	2921.6
ME		2240.2	3494.7	5037.5	6220.6	6234.1	6245.5
World		2484.7	4108.0	6258.3	8030.4	8214.8	8255.0

Source: Metall Statistik; for 1983: World Metal Statistics

1) Excluding CPE
2) Excluding South Africa
3) Composition of restgroups is not the same in all periods considered
4) Excluding Japan and China
5) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea
6) 50/51

TABLE 1.2

World mine production (percentage shares of ME)

Country		49/51	59/61	69/71	79/81	82	83
DME	Finland	0.8	0.9	0.6	0.6	0.6	0.6
	Norway	0.7	0.4	0.4	0.5	0.4	0.4
	Spain	0.8	0.5	0.5	0.8	0.9	1.0
	Sweden	0.7	0.5	0.5	0.7	0.9	1.0
	Yugosl.	1.8	1.0	1.8	1.8	1.9	2.1
	Other Eur. 1)	0.3	0.5	0.4	0.1	0.1	0.1
	Total Eur. 1)	5.0	3.8	4.2	4.6	4.9	5.2
	Canada	10.8	11.0	11.8	11.0	9.7	10.0
	USA	35.0	26.6	28.7	22.3	18.3	16.6
	N.America	45.7	37.6	40.5	33.3	28.0	26.6
	S. Africa	1.5	1.5	2.9	3.4	3.3	3.4
	Japan	1.7	2.6	2.4	0.9	0.8	0.7
	Australia	0.7	2.9	3.1	3.8	3.9	4.2
	Total	54.7	48.3	53.1	45.9	40.9	40.2
LDC	Namibia	0.5	0.7	0.5	0.7	0.8	0.8
	Uganda	-	0.4	0.3	-	-	-
	Zaïre	7.4	8.4	7.7	7.3	8.1	8.0
	Zambia	13.0	16.2	13.6	9.5	8.5	9.3
	Zimbabwe	-	-	-	0.4	0.4	0.4
	Other Afr.2,3)	0.1	0.5	0.6	0.4	0.6	0.7
	Total Afr. 2)	21.2	26.2	22.7	18.3	18.4	19.2
	Chile	16.6	15.5	13.8	17.2	19.9	20.1
	Mexico	2.8	1.6	1.3	2.7	3.8	3.3
	Peru	1.3	4.1	4.1	5.8	5.7	5.2
	Lat. Am.	21.8	21.7	19.6	26.0	29.9	29.2
	India	0.3	0.2	0.2	0.4	0.4	0.7
	Indonesia	-	-	-	1.0	1.2	1.3
	Malaysia	-	-	-	0.4	0.5	0.5
	Philipp.	0.4	1.4	3.2	4.9	4.7	4.3
	Turkey	0.6	0.8	0.6	0.5	0.5	0.4
	Other Asia1,3,4)	1.1	1.3	0.7	0.1	0.8	1.3
	Dev. Asia 1,4)	2.5	3.8	4.7	7.2	8.1	8.4
	Pap.N.Guin.	-	-	-	2.6	2.7	2.9
	Total	45.3	51.7	46.9	54.1	59.1	59.8
CPE	Bulgaria	-	0.3	0.8	1.0	1.1	1.3
	Mongolia	-	-	-	0.7	1.5	1.5
	Poland	0.1 6)	0.3	1.7	5.2	6.0	6.4
	USSR	10.0	14.2	18.5	18.2	18.9	18.9
	China and oth.Asia	0.9	2.7	3.3	3.9	4.2	3.0
	Total	10.9	17.5	24.2	29.1	31.8	32.2
CIPEC 5)		38.5	44.2	39.2	43.4	46.1	46.8
ME		100	100	100	100	100	100
World		110.9	117.5	124.2	129.1	131.8	132.2

Source: Metall Statistik; for 1983 World Metal Statistics

1) Excluding CPE
2) Excluding South Africa
3) Composition of restgroups is not the same in all periods considered
4) Excluding Japan and China
5) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea
6) 50/51

TABLE 1.3

World mine production (growth rates)

Country		50/60	60/70	70/80		50/80
DME	Finland	5.8	0.2	2.3		2.1
	Norway	- 0.1	3.7	3.2		2.2
	Spain	0.3	3.1	7.4		3.6
	Sweden	1.3	4.4	5.5		3.7
	Yugosl.	- 1.1	9.1	2.4		2.8
	Other Eur. 1)	8.4	1.5	- 7.1		0.7
	Total Eur. 1)	1.7	4.8	3.1		3.2
	Canada	4.8	4.4	1.4		3.5
	USA	1.7	4.5	- 0.4		1.9
	N.America	2.5	4.5	0.1		2.4
	S.Africa	4.6	10.9	3.7		6.4
	Japan	8.9	2.9	- 7.6		1.2
	Australia	20.8	4.3	4.3		9.6
	Total	3.1	4.3	0.7		2.9
LDC	Namibia	8.8	- 0.4	5.4		4.5
	Uganda	-	2.2	-		-
	Zaïre	5.6	2.8	1.7		3.3
	Zambia	6.8	1.9	- 1.5		2.4
	Other Afr. 2,3)	29.2	4.7	- 0.9		10.3
	Total Afr. 2)	6.8	2.2	0.0		3.0
	Chile	3.8	2.5	4.4		3.6
	Mexico	- 1.1	1.3	10.4		3.4
	Peru	17.0	3.8	5.7		8.7
	Lat. Am.	4.5	2.7	5.0		4.1
	India	2.1	1.8	10.0		4.6
	Philipp.	17.1	12.9	6.3		12.0
	Turkey	8.1	- 0.5	0.2		2.5
	Other Asia 1,3,4)	6.1	- 2.8	-16.6		- 4.9
	Dev. Asia 1,4)	9.1	6.0	6.7		7.2
	Total	5.9	2.7	3.6		4.1
CPE	Bulgaria	-	13.0	4.1		-
	Poland	-	23.1	14.5		-
	USSR	8.3	6.5	2.0		5.6
	China and oth.Asia	17.3	5.8	3.9		9.1
	Total	9.6	7.1	4.0		6.9
CIPEC 5)		6.0	2.5	3.2		4.1
ME		4.5	3.7	2.1		3.5
World		5.2	4.3	2.5		4.1

Source: Metall Statistik

1) Excluding CPE
2) Excluding South Africa
3) Composition of restgroup is not the same in all periods considered
4) Excluding Japan and China
5) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 2.1

World smelter production (in 1000 MT)

Country		49/51	59/61	69/71	79/81	82	83
DME	Finland	16.6	33.0	33.5	51.9	66.2	70.1
	Norway	9.0	20.8	31.6	31.0	24.4	26.5
	Spain	8.1	15.0	54.8	100.4	105.0	89.0
	Sweden	15.4	18.0	34.4	52.7	72.5	78.8
	UK	22.0	5.7	-	-	-	-
	Yugosl.	35.5	34.0	85.2	98.3	84.0	86.8
	Germ. FR	46.7	63.6	87.7	163.1	161.8	159.1
	Total Eur. [1]	168.7	217.5	346.7	499.6	517.9	515.9
	Canada	209.2	351.0	430.3	448.8	366.6	336.9
	USA	878.4	992.7	1429.4	1220.3	975.4	927.7
	N.America	1087.6	1343.7	1859.7	1669.1	1342.0	1264.6
	S.America	32.0	50.2	145.2	184.5	191.8	192.3
	Japan	39.8	184.3	493.1	891.1	948.2	944.6
	Australia	13.7	68.4	123.6	166.2	165.3	173.6
	Total	1341.8	1864.1	2968.3	3410.5	3165.2	3091.0
LDC	Namibia	-	-	27.8	40.8	49.8	54.2
	Uganda	-	13.4	16.5	0.1	-	-
	Zaïre [2]	166.2	292.3	383.8	421.4	466.4	465.8
	Zambia	286.1	561.2	676.7	592.0	580.7	562.7
	Zimbabwe	-	-	-	27.5	30.5	31.2
	Other Afr.[3,4]	33.1	55.3	21.8	-	-	-
	Total Afr. [3]	453.4	872.0	1126.6	1081.8	1127.4	1113.9
	Chile	352.1	515.5	639.7	951.9	1046.8	1058.1
	Mexico	55.1	49.5	62.1	80.4	61.7	66.9
	Peru	22.9	125.6	170.6	331.5	289.7	295.9
	Brazil	-	-	-	-	4.8	63.1
	Lat. Am.	430.0	692.2	876.7	1363.8	1407.8	1484.0
	India	6.9	8.6	9.4	25.3	32.6	35.4
	Philipp.	-	-	-	-	-	38.8
	Turkey	13.5	23.7	18.6	21.8	25.3	18.3
	Other Asia[1,4,5]	0.8	3.0	10.0	102.7	156.8	206.5
	Dev. Asia [1,5]	21.2	35.3	38.0	149.8	214.7	298.0
	Total [1]	904.6	1599.5	2041.3	2595.4	2749.9	2895.9
CPE	Bulgaria	-	15.4	42.2	59.7	70.0	60.0
	Poland	-	16.3	70.3	309.3	308.0	320.0
	USSR	224.0	496.7	930.0	1160.0	1220.0	1280.0
	China and oth.Asia	4.3	64.0	111.3	195.7	222.0	230.0
	Total	246.1	619.6	1206.1	1799.8	1898.0	1969.7
CIPEC [6]		627.3	1494.6	1870.8	2296.8	2383.6	2382.5
ME		2246.4	3463.7	5009.6	6005.9	5915.1	5986.9
World		2492.5	4083.3	6215.7	7805.7	7813.1	7956.6

Source: Metall Statistik; smelter production fromores only

1) Excluding CPE
2) Includes leach cathodes
3) Excluding South Afria
4) Composition of restgroups is not the same in all periods considered
5) Excluding Japan and China
6) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papuea New Guinea

TABLE 2.2

World smelter production (percentage shares of ME)

Country		49/51	59/61	69/71	79/81	82	83
DME	Finland	0.7	1.0	0.7	0.9	1.1	1.2
	Norway	0.4	0.6	0.6	0.5	0.4	0.4
	Spain	0.4	0.5	1.1	1.7	1.8	1.5
	Sweden	0.7	0.5	0.7	0.9	1.2	1.3
	UK	1.6	0.2	-	-	-	-
	Yugosl.	1.6	1.0	1.7	1.4	1.4	1.4
	Germ. FR	2.1	1.8	1.8	2.7	2.7	2.7
	Total Eur. 1)	7.5	6.3	6.9	8.3	8.8	8.6
	Canada	9.3	10.1	8.6	7.5	6.2	5.6
	USA	39.1	28.7	28.5	20.3	16.5	15.5
	N.America	48.4	38.8	37.1	27.8	22.7	21.1
	S. Africa	1.4	1.4	2.9	3.1	3.2	3.2
	Japan	1.8	5.3	9.8	14.8	16.0	15.8
	Australia	0.6	2.0	2.5	2.8	2.8	2.9
	Total	59.7	53.8	59.3	56.8	53.5	51.6
LDC	Namibia	-	-	0.6	0.7	0.8	0.9
	Uganda	-	0.4	0.3	-	-	-
	Zaïre 2)	7.4	8.4	7.7	7.0	7.9	7.8
	Zambia	12.7	16.2	13.5	11.3	9.8	9.4
	Zimbabwe	-	-	-	0.5	0.5	0.5
	Other Afr. 3,4)	1.5	1.0	0.4	-	-	-
	Total Afr. 3)	20.2	25.2	22.5	18.0	19.1	18.6
	Chile	15.7	14.9	12.8	15.8	17.7	17.7
	Mexico	2.5	1.4	1.2	1.3	1.0	1.1
	Peru	1.0	3.6	3.4	5.5	4.9	4.9
	Lat.Am.	19.1	20.0	17.5	22.7	23.8	24.8
	India	0.3	0.2	0.2	0.4	0.6	0.6
	Philipp.	-	-	-	-	-	0.6
	Turkey	0.6	0.7	0.4	0.4	0.4	0.3
	Other Asia 1,4,5)	-	0.1	0.2	1.7	2.7	3.4
	Dev. Asia 1,5)	0.9	1.0	0.8	2.5	3.6	5.0
	Total 1)	40.3	46.2	40.7	43.2	46.5	48.4
CPE	Bulgaria	-	0.4	0.3	1.0	1.2	1.0
	Poland	-	0.5	1.4	5.1	5.2	5.3
	USSR	10.0	14.3	18.6	19.3	20.6	21.4
	China and oth.Asia	0.2	1.8	2.2	3.3	3.8	3.8
	Total	11.0	17.9	24.1	30.0	32.1	32.9
CIPEC 6)		27.9	43.2	37.3	38.2	40.3	39.8
ME		100	100	100	100	100	100
World		111.0	117.9	124.1	130.0	132.1	132.9

Source: Metall Statistik

1) Excluding CPE
2) Includes leach cathodes
3) Excluding South Africa
4) Composition of restgroups is not the same in all periods considered
5) Excluding Japan and China
6) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 2.3

World smelter production (growth rates)

Country		50/60	60/70	70/80	50/80
DME	Finland	7.1	0.2	4.5	3.9
	Norway	8.7	4.3	- 0.2	4.2
	Spain	6.8	13.4	6.2	8.8
	Sweden	1.6	6.7	4.4	4.2
	UK	- 12.9	- 100	-	- 100
	Yugosl.	- 0.4	9.6	1.4	3.5
	Germ. FR	3.1	3.3	6.4	4.3
	Total Eur. 1)	2.6	4.8	3.7	3.7
	Canada	5.3	2.1	0.4	2.6
	USA	1.2	3.7	- 1.6	1.1
	N.America	2.1	3.3	- 1.1	1.4
	S. Africa	4.6	11.2	2.4	6.2
	Japan	16.6	10.3	6.1	10.9
	Australia	17.4	6.1	3.0	8.7
	Total	3.3	4.8	1.4	3.2
LDC	Namibia	-	-	3.9	-
	Uganda	-	2.1	-40.0	-
	Zaïre 2)	5.8	2.8	0.9	3.1
	Zambia	7.0	1.9	- 1.3	2.5
	Other Afr. 3,4)	5.3	- 8.9	- 100	- 100
	Total Afr. 3)	6.8	2.6	- 0.4	2.9
	Chile	3.9	2.2	4.1	3.4
	Mexico	- 1.1	2.3	2.6	1.3
	Peru	18.6	3.1	6.9	9.3
	Lat. Am.	4.9	2.4	4.5	4.0
	India	2.2	0.9	10.4	4.4
	Turkey	5.8	- 2.4	1.6	1.6
	Other Asia 1,4,5)	40.3	12.8	26.2	17.6
	Dev. Asia 1,5)	5.2	0.7	14.7	6.7
	Total 1)	5.9	2.5	2.4	3.6
CPE	Bulgaria	-	10.6	3.5	-
	Poland	-	15.7	16.0	-
	USSR	8.3	15.7	2.2	5.6
	China and oth.Asia	47.6	6.5	5.8	13.6
	Total	9.7	6.9	4.1	6.9
CIPEC 6)		9.1	2.3	2.1	4.4
ME		4.4	3.8	1.8	3.3
World		5.1	4.3	2.3	3.9

Source: Metall Statistik

1) Excluding CPE
2) Includes leach cathodes
3) Excluding South Africa
4) Composition of restgroups is not the same in all periods considered
5) Excluding Japan and China
6) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 3.1

World refined production (1000 MT)

Country		49.51	59/61	69/71	79/81	82	83
DME	Belgium	137.6	192.5	312.4	403.2	437.9	404.6
	Finland	16.6	32.6	33.4	39.1	48.0	55.4
	Norway	6.6	16.7	25.2	24.6	18.0	22.7
	Spain	14.4	48.0	77.9	148.7	171.9	158.6
	Sweden	25.0	38.2	50.9	59.8	62.3	63.4
	UK	194.3	211.5	194.0	139.7	134.1	144.4
	Yugosl.	18.2	34.1	88.0	133.8	126.9	123.7
	Germ. FR	183.1	298.4	402.7	381.2	393.6	420.3
	Total Eur. 1)	637,4	958.0	1257.8	1437.1	1505.1	1514.7
	Canada	214.6	359.5	461.9	459.7	312.4	464.3
	USA	1217.3	1509.2	1941.4	1882.4	1672.2	1583.7
	N.America	1431.9	1868.7	2403.3	2342.1	1984.6	2047.0
	S. Africa	12.0	14.6	71.9	148.3	142.5	157.7
	Japan	83.6	239.7	682.0	1016.0	1075.0	1091.9
	Australia	23.0	75.4	148.6	181.6	182.7	201.9
	Total	2187.5	3156.4	4564.2	5152.1	4889.9	5013.2
LDC	Zaïre 2)	88.5	150.5	193.6	132.8	175.1	226.9
	Zambia	83.0	397.4	572.8	578.2	587.0	575.4
	Total Afr. 3)	172.1	552.5	790.0	723.8	790.2	830.1
	Chile	309.0	237.2	461.9	788.8	851.6	833.4
	Mexico	15.4	28.1	54.4	91.5	74.4	80.3
	Peru	21.5	30.3	34.4	223.3	224.9	190.6
	Lat. Am.	345.9	298.9	566.8	1136.9	1196.2	1192.7
	India	6.8	8.3	9.6	21.9	26.2	28.1
	Philipp.	-	-	-	-	-	38.8
	Turkey	2.8	11.2	13.6	21.2	32.2	31.8
	Other Asia 1,4,5)	-	-	15.0	114.0	164.2	186.6
	Dev. Asia 1,5	9.6	23.7	38.2	157.1	222.6	285.3
	Total	527.6	875.1	1395.0	2017.8	2209.0	2308.1
CPE	Bulgaria	-	12.4	38.5	62.3	65.0	62.0
	Poland	10.7	20.5	73.2	340.1	348.0	360.1
	USSR	288.3	606.7	1081.7	1463.3	1520.0	1500.0
	China and oth.Asia	4.6	93.3	141.7	315.0	319.0	345.0
	Total	334.3	784.9	1434.3	2343.5	2404.7	2412.0
CIPEC 6)		502.0	606.3	1262.7	1723.1	1838.6	1826.3
ME		2715.1	4031.5	5959.2	7142.9	7098.9	7322.3
World		3049.4	4816.4	7393.5	9486.4	9503.6	9734.3

Source: Metall Statistik

1) Excluding CPE
2) Excludes leach cathodes
3) Excluding South Africa
4) Composition of restgroups is not the same in all periods considered
5) Excluding Japan and China
6) CIPEC = Chile, Peru. Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 3.2

World refined production (percentage shares)

Country		49/51	59/61	69/71	79/81	82	83
DME	Belgium	5.1	4.8	5.2	5.6	6.2	5.5
	Finland	0.6	0.8	0.6	0.5	0.7	0.8
	Norway	0.2	0.4	0.4	0.4	0.3	0.3
	Spain	0.5	1.2	1.3	2.1	2.4	2.2
	Sweden	0.9	0.9	0.9	0.8	0.9	0.9
	UK	7.2	5.2	3.3	2.0	1.9	2.0
	Yugosl.	0.7	0.8	1.5	1.9	1.8	1.7
	Germ. FR	6.7	7.4	6.8	5.3	5.5	5.7
	Total Eur. 1)	23.5	23.8	21.1	20.1	21.2	20.7
	Canada	7.9	8.9	7.8	6.4	4.4	6.3
	USA	44.8	37.4	32.6	26.4	23.6	21.6
	N.America	52.7	46.4	40.3	32.8	28.0	28.0
	S. Africa	0.4	0.4	1.2	2.1	2.0	2.2
	Japan	3.1	5.9	11.5	14.2	15.1	14.9
	Australia	0.8	1.9	2.5	2.5	2.6	2.8
	Total	80.6	78.3	76.6	71.8	68.9	68.5
LDC	Zaïre 2)	3.3	3.7	3.2	1.9	2.5	3.1
	Zambia	3.1	9.9	9.6	8.1	8.3	7.9
	Total Afr. 3)	6.3	13.7	13.3	10.1	11.1	11.3
	Chile	11.4	5.9	7.8	11.0	12.0	11.4
	Mexico	0.6	0.7	0.9	1.4	1.0	1.1
	Peru	0.8	0.8	0.6	3.1	3.2	2.6
	Lat. Am.	12.7	7.4	9.5	15.9	16.9	16.3
	India	0.3	0.2	0.2	0.3	0.4	0.4
	Philipp.	-	-	-	-	-	0.5
	Turkey	0.1	0.3	0.2	0.3	0.5	0.4
	Other Asia 1,4,5)	-	-	0.3	1.6	2.3	2.5
	Dev. Asia 1,5)	0.4	0.6	0.6	2.2	3.1	3.9
	Total	19.4	21.7	23.4	28.2	31.1	31.5
CPE	Bulgaria	-	0.3	0.6	0.9	0.9	0.8
	Poland	0.4	0.5	1.2	4.8	4.9	4.9
	USSR	10.6	15.0	18.2	20.5	21.4	20.5
	China and oth.Asia	0.2	2.3	2.4	4.4	4.5	4.7
	Total	12.3	19.5	24.1	32.8	31.1	32.9
CIPEC 6)		18.5	15.0	21.2	24.1	25.9	24.9
ME		100	100	100	100	100	100
World		112.3	119.5	124.1	132.8	133.9	132.9

Source: Metall Statistik

1) Excluding CPE
2) Excludes leach cathodes
3) Excluding South Africa
4) Composition of restgroups is not the same in all periods considered
5) Excluding Japan and China
6) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 3.3

World refined production (growth rates)

Country		50/60	60/70	70/80	50/80
DME	Belgium	3.4	5.0	2.6	3.6
	Finland	7.0	0.2	1.6	2.9
	Norway	9.7	4.2	- 0.2	3.4
	Spain	12.8	5.0	6.7	8.6
	Sweden	4.3	2.9	1.0	3.1
	UK	0.9	- 0.9	- 3.2	- 1.1
	Yugosl.	6.5	9.9	4.3	6.9
	Germ. FR	5.0	3.0	- 0.4	2.5
	Total Eur. 1)	4.2	2.8	1.3	2.7
	Canada	5.3	2.5	-	2.6
	USA	2.2	2.6	- 0.3	1.5
	N.America	2.7	2.5	- 0.3	1.7
	S. Africa	2.0	17.3	7.5	8.7
	Japan	11.0	39.8	4.1	8.7
	Australia	12.6	7.0	2.0	7.1
	Total	3.7	3.8	1.2	2.7
LDC	Zaïre 2)	5.5	2.6	- 3.7	2.3
	Zambia	17.0	3.7	0.1	6.7
	Total Afr. 3)	12.4	3.6	- 0.9	5.2
	Chile	- 2.6	6.9	5.5	3.4
	Mexico	6.2	6.8	5.3	5.4
	Peru	3.5	1.3	20.6	8.1
	Lat. Am.	- 1.4	6.6	7.2	4.2
	India	2.0	1.5	8.6	4.6
	Turkey	-	2.0	4.5	-
	Other Asia 1,4,5)	-	-	22.5	-
	Dev. Asia 1,5)	9.5	4.9	15.2	11.0
	Total	5.2	4.8	3.8	4.9
CPE	Poland	6.7	12.0	4.9	12.3
	USSR	7.7	13.6	16.6	5.7
	China and oth.Asia	35.1	6.0	3.1	15.2
	Total	8.9	6.2	5.0	6.8
CIPEC 6		1.9	7.6	3.2	4.4
ME		4.0	4.0	1.8	3.3
World		4.7	4.4	2.5	3.9

Source: Metall Statistik

1) Excluding CPE
2) Excludes leach cathodes
3) Excluding South Africa
4) Composition of restgroups is not the same in all periods considere
5) Excluding Japan and Chile
6) CIPEC = Chile, Peru, Zambia, Zaïre, Indonesia, Papua New Guinea

TABLE 4.1.1

Production of secondary refined copper (in 1000 MT)

Country	49/51	59/61	69/71	79/81	82	83
Belgium [1]			65.3	60.7	60.0	71
France			27.7	33.7	27.0	41
Germany FR	113.9	126.8	180.0	184.5	177.1	182
Italy			19.0	14.1	19.6	31
UK	73.5	97.9	129.1	80.8	71.0	77
Yugoslavia			2.8	39.9	44.4	
Europe			464.1	490.2	489.8	491
Japan	45.5	58.0	104.4	125.0	126.8	147
South Korea				13.6	4.0	12
Canada				35.3	24.0	35
USA	196.8	249.1	399.3	459.0	447.1	399
North America				494.3	471.1	434
Brazil			14.0	33.2	35.7	25
Mexico			6.0	11.1	12.7	6
Australia			37.9	32.7	17.8	44
ME	454.7	641.7	1082.7	1200.2	1157.9	1159

Source: Metall Statistik, 1983, World Metal Statistics

1) Including Luxembourg

TABLE 4.1.2

Production of secondary refined copper (percentage shares and growth rates)

	Percentages shares						Growth rates			
Country	49/51	59/61	69/71	79/81	82	83	50/60	60/70	70/80	50/80
Belgium 1)			6.0	5.1	5.2	6.1			- 0.7	
France			2.6	2.8	2.3	3.5			2.1	
Germany FR	25.0	19.8	16.6	15.4	15.3	15.7	1.1	3.6	0.2	1.5
Italy			1.8	1.2	1.7	3.7			- 2.9	
UK	12.6	15.3	11.9	6.7	6.1	6.6	2.9	2.8	- 4.0	- 0.1
Yugosl.			0.3	3.3	3.8				30.4	
Europe			42.9	40.8	42.3	42.4			0.5	
Japan	10.0	9.0	9.6	10.4	11.0	12.7	2.5	6.1	1.8	3.5
S.Korea				1.1	0.3	1.0				
Canada				2.9	2.1	3.0				
USA	43.3	38.8	36.9	38.2	38.6	34.4	2.4	4.8	1.4	2.8
N.America				41.2	40.7	37.4				
Brazil			1.3	2.8	3.1	2.1			9.0	
Mexico			0.6	0.9	1.1	0.5			0.3	
Australia			3.5	2.7	1.5	3.8			- 1.5	
ME	100	100	100	100	100	100	3.5	5.4	1.0	3.2

Source: Metall Statistik

1) Including Luxembourg

TABLE 4.2.1

Direct scrap used by manufactures (in 1000 MT)

Country	49/51	59/61	69/71	79/81	82	83
Netherlands	5.3	13.0	26.0	18.3	21.0	28
Belgium	26.7	33.4	35.3 1)	29.3 1)	29.1 1)	
France	41.8	103.8	136.2	119.5	113	104
Germany FR	66.8	123.7	177.9	236.6	222.2	251
Italy	26.1	74.0	159.3	200.3	183.0	192
UK	127.7	165.9	130.4	122.3	127	110
Yugoslavia			30.3	44.3	49.0	50
Europe	351.4	591.4	810.4	887.0	853.2	879
South Africa			15.0	28.3	30	27
Other Africa			5.0	4.3	4	4
Japan	79.7	190.0	351.7	417.0	476.0	518
South Korea				23.7	18.0	
Taiwan				15.7	12.0	
Dev. Asia				98.0	120.0	150
Canada	30.3	40.3	42.7	21.6	9.0	24
USA	675.7	686.5	870.9	910.9	698.0	784
North America	706.0	726.8	913.6	932.5	707.0	808
Brazil			14.8	23.0	21.0	17
Latin America			70	96.3	104.0	68
Australia			37.7	44.3	43.0	42
ME	1137.1	1508.1	2219.2	2507.8	2334.2	2496

Source: Metall Statistik and World Metal Statistic (World Metal Statistics inc udes scrap in ingot form)

1) Including Luxembourg

TABLE 4.2.2

Direct scrap used by manufactures (percentages shares and growth rates)

	Percentages shares						Growth rates			
Country	49/51	59/61	69/71	79/81	82	83	50/60	60/70	70/80	50/80
Netherl.	0.5	0.9	1.2	0.7	0.9	1.1	9.4	7.2	- 3.5	4.2
Belg. [1]	2.3	2.2	1.6	1.2	1.2		2.3	0.6	- 1.8	0.3
France	3.7	6.9	6.1	4.8	4.8	4.2	9.5	2.8	- 1.3	3.6
Germ.FR	5.9	8.2	8.0	9.4	9.5	10.0	6.4	3.7	2.9	4.3
Italy	2.3	4.9	7.2	8.0	7.8	7.7	11.0	7.9	2.3	7.0
UK	11.2	11.0	5.9	4.9	5.4	4.4	2.7	- 2.4	- 0.6	- 0.1
Yugsl.			1.4	1.8	2.1	2.0			3.9	
Europe	30.9	39.2	36.5	35.4	36.6	35.2	5.3	3.2	0.9	3.1
S.Africa			0.7	1.1	1.3	1.1			6.6	
Oth.Afr.			0.2	0.2	0.2	0.2			- 1.5	
Japan	7.0	12.6	15.8	16.6	20.4	20.8	9.1	6.4	1.7	5.7
S.Korea				0.9	0.8					
Taiwan				0.6	0.5					
Dev.Asia				3.9	5.1	6.0				
Canada	2.7	2.7	1.8	0.9	0.4	1.0	2.9	0.6	- 6.6	- 1.1
USA	59.4	45.5	39.2	36.3	299.9	31.4	0.2	2.4	0.5	1.0
N.America	62.1	48.2	41.2	37.2	30.3	32.4	0.3	2.3	0.2	0.9
Brazil			0.7	0.9	0.9	0.7			4.5	
Lat.Amer.			2.8	3.8	4.2	2.7			3.2	
Australia			1.7	1.8	1.8	1.7			1.6	
ME	100	100	100	100	100	100	2.9	3.9	1.2	2.7

Source: Metall Statistik complemented with World Metal Statistics (World Metal Statistics incl.scrap in ingot form)

1) Partly including Luxembourg

TABLE 5.1.1

World trade in ores and concentrates, exports (in 1000 MT Cu contents)

Country		59/61	69/71	79/81	82	83
DME	Norway	-	9.2	20.6	9.5	19.4
	Spain	2.0	-	4.7	-	-
	Sweden	-	-	-	11.3	8.4
	Yugoslavia	-	-	1.6	-	-
	Canada	37.1	169.9	293.7	252.8	313.8
	USA	-	21.4	100.7	195.3	42.7
	South Afr.	-	-	24.0	14.5	15.2
	Australia	107.9	24.7	49.3	63.3	71.9
LDC	Zaïre	-	-	35.1	36.0	36.0
	Zambia	-	12.7	-	-	-
	Chile	21.0	52.6	112.3	200.9	196.2
	Mexico	9.3[1)]	4.8[1)]	76.1	132.0	195.1
	Peru	16.7	34.5	24.6	38.4	41.0
	Indonesia	-	-	60.1	76.4	76.9
	Malaysia	-	-	26.7	30.9	29.1
	Philipp.	-	163.0	296.0	280.0	211.7
	Turkey	-	12.1	8.0	-	-
	Pa.N.Guinea	-	-	160.8	173.3	182.5
DME			225.2	499.3	558.6	472.6
LDC			297.1	822.7	980.5	1012.6
Total			522.2	1322.0	1539.1	1485.2

Source: Metall Statistik and World Metal Statistics

1) Gross weights

TABLE 5.1.2

World trade in ores and concentrates, exports (percentage share of ME)

Country		69/71	79/81	82	83
DME	Norway	1.8	1.6	0.6	1.3
	Spain	-	0.4	-	-
	Sweden	-	-	0.7	0.6
	Yugoslavia	-	0.1	-	-
	Canada	56.2	22.2	16.4	21.1
	USA	19.3	7.6	12.7	2.9
	South Africa	-	1.8	0.9	1.0
	Australia	4.7	3.7	4.1	4.8
LDC	Zaïre	-	2.7	2.3	2.4
	Zambia	2.4	-	-	-
	Chile	10.1	8.5	13.1	13.2
	Mexico	-	5.8	8.6	13.1
	Peru	6.6	1.9	2.5	2.8
	Indonesia	-	4.5	5.0	5.2
	Malaysia	-	2.0	2.0	2.0
	Philippines	31.2	22.0	18.2	14.3
	Turkey	2.3	0.6	-	-
	Pa.N.Guinea	-	12.2	11.3	12.3
DME		43.1	37.8	36.3	31.8
LDC		56.9	62.2	63.7	68.2
Total ME		100	100	100	100

Source: Metall Statistik and World Metal Statistics

TABLE 5.1.3

World trade in ores and concentrates, exports (average annual growth rates)

Country		60/70	70/80
DME	Norway	-	8.4
	Canada	16.4	5.6
	USA	-	16.8
	Australia	-	7.2
LDC	Chile	9.6	7.9
	Peru	7.5	- 3.3
	Philippines	-	6.1
	Turkey	-	- 4.1
DME		-	8.3
LDC		-	10.7
Total ME		-	9.7

Source: Table 6.1

TABLE 5.2.1

World trade in ores and concentrates, imports (in 1000 MT

Country	59/60/61	69/70/71	79/80/81	82	83
Austria	0.4[1]	-	-	4.0	-
Belgium	0.9[2]	5.9	1.8	-	2.7
France	-	-	7.1	-	-
Finland	-	-	21.8	15.6	23.9
Germany FR	135.5	85.4	137.4	150.3	139.6
Norway	-	-	-	18.6	3.2
Spain	24.8[1]	24.9	47.3	63.0	58.3
Sweden	25.7	10.8	19.0	28.5	26.4
Yugoslavia	-	-	5.7	-	2.5
USA	63.4	31.2	39.3	110.7	109.2
Japan	-	382.7	842.7	979.5	846.5
S. Korea	-	-	71.8	118.3	111.4
Taiwan	-	-	34.0	21.4	33.5
DME	-	540.9	1122.1	1370.2	1212.3
LDC	-	-	105.9	139.7	144.9
Total	-	540.9	1228.0	1509.9	1357.2

Source: Metall Statistik and World Metal Statistics
1) Gross weights
2) Including Luxembourg

TABLE 5.2.2

World trade in ores and concentrates, imports (percentage shares)

Country	69/70/71	79/80/81	82	83
Austria	-	-	4.0	-
Belgium	1.1	0.1	-	0.2
France	-	0.6	-	-
Finland	-	1.8	1.0	1.8
Germany FR	15.8	11.2	10.0	10.3
Norway	-	-	1.2	0.2
Spain	4.6	3.9	4.2	4.3
Sweden	10.8	1.5	1.9	1.9
Yugoslavia	-	0.5	-	0.2
USA	5.8	3.2	7.3	8.0
Japan	70.8	68.6	64.9	62.4
S. Korea	-	5.8	7.8	8.2
Taiwan	-	2.8	1.4	2.5
DME	100	91.4	90.7	89.3
LDC	0.0	8.6	9.3	10.7
Total	100	100	100	100

Source: World Metal Statistics

TABLE 6.1.1

World trade in unrefined copper (blister and anode copper), exports (in 1000 MT

Country		49/50/51	59/60/61	69/70/71	79/80/81	82	83
DME	Belgium	-	-	1.7	7.2	11.9	11.3
	Finland	-	-	-	12.3	13.8	15.0
	France	-	6.0	8.4	4.3	3.5	6.6
	Germ. FR	-	0.6	0.9	22.1	18.8	17.0
	Italy	-	-	2.1	0.1	0.3	0.2
	Norway	-	-	6.4	6.5	6.7	6.2
	Spain	-	-	0.8	0.4	-	1.0
	Sweden	-	0.1	2.8	5.2	25.7	40.2
	UK	27.7	-	-	-	-	-
	USA	0.3	5.6	12.3	6.8	2.0	7.5
	S. Africa	-	-	97.3	35.6	39.1	34.7
	Australia	-	6.0	7.1	21.2	7.3	8.4
LDC	Namibia	-	-	-	41.6	44.4	46.8
	Uganda	-	-	16.4	-	-	-
	Zaïre	80.1	110.3	192.7	272.1	323.3	231.8
	Zambia	198.2	158.6	103.4	8.1	-	-
	Zimbab.[1)]	-	-	-	9.0	22.7	24.9
	Chile	-	277.0	182.8	163.0	198.9	224.4
	Mexico	-	26.2	7.3	5.1	9.5	11.9
	Peru	-	92.6	139.2	123.3	97.0	92.7
	Turkey	-	-	4.6	-	-	8.4
DME		-	-	140.0	86.0	129.1	148.1
LDC		-	-	646.4	662.4	695.8	632.5
Total		-	-	786.2	748.4	824.9	780.6

Source: World Metal Statistics and Metall Statistik

1) Including refined

TABLE 6.1.2

World trade unrefined copper, exports (percentage share of ME

Country		69/70/71	79/80/81	82	83
DME	Austria	-	-	-	-
	Belgium	0.2	1.0	1.4	1.5
	Finland	-	1.6	1.6	1.9
	France	1.1	0.6	0.4	0.8
	Germ.FR	0.1	3.0	2.2	2.2
	Italy	0.3	-	-	-
	Norway	0.8	6.3	0.8	0.8
	Spain	0.1	0.1	-	0.1
	Sweden	0.4	0.7	3.0	5.1
	UK	-	-	-	-
	USA	1.6	0.9	2.0	2.0
	S.Africa	12.4	4.8	4.6	4.4
	Austral.	0.9	2.8	0.9	1.1
LDC	Namibia	-	5.6	5.3	6.0
	Uganda	2.1	-	-	-
	Zaïre	24.5	36.4	38.4	29.7
	Zambia	13.2	1.1	-	-
	Zimb. 1)	-	1.2	2.7	3.2
	Chile	23.3	21.8	23.6	28.7
	Mexico	0.9	0.7	1.1	1.5
	Peru	17.7	16.5	11.5	11.9
	Turkey	0.6	-	-	-
DME		17.8	11.5	15.7	19.0
LDC		82.2	88.5	84.3	81.0
Total		100	100	100	100

Source: World Metal Statistics and Metall Statistik
1) Includes refined

TABLE 6.1.3

World trade unrefined exports (annual average growth rate)

50/60	60/70	70/80	50/80
-	-100.0	-	-
-	-	15.5	-
-	-	-	-
-	3.4	- 6.5	-
-	4.1	37.7	
-	-	-26.2	-
-	-	- 0.2	-
-	-	- 6.7	-
-	39.5	6.4	-
-100.0	-	-	-
34.0	8.2	- 5.8	6.5
-	-	- 9.5	-
-	1.7	11.6	-
-	-	-	-
-	-	-100.0	-
3.3	5.7	3.5	4.8
- 2.2	- 4.2	- 22.5	-10.1
-	-	-	-
-	- 4.1	- 1.1	-
-	-12.0	- 3.5	-
-	- 4.2	- 1.2	
-	-	-	-
-	-	11.0	-
-	-	- 1.0	
-	-	1.2	

TABLE 6.2.1

World trade in unrefined copper (blister and anode copper), imports (in 1000 MT)

Country	49/50/51	59/60/61	69/70/71	79/80/81	82	83
Austria		3.9	5.7	8.6	8.7	8.5
Belgium			186.6	188.7	213.8	194.3
France	10.8	7.1	16.2	19.0	22.5	14.4
Germany FR		133.1	144.6	60.1	81.2	68.9
Italy		10.3	2.5	3.4	1.1	2.7
Portugal			1.6	1.4	1.5	
Spain			11.5	37.3	22.0	17.9
Sweden		2.7	4.9			
UK	121.0	117.8	39.5	67.3	68.1	83.7
Yugoslavia			13.5	29.6	21.9	5.4
USA	156.8	274.2	187.2	63.6	106.2	82.1
Japan			134.0	80.3	77.9	55.5
DME			747.9	559.2	624.9	533.4
LDC						
Total			747.9	559.2	624.9	533.4

Sources: World Metal Statistics and Metall Statistik

TABLE 6.2.2

World Trade unrefined copper, imports (perc.shares of ME)

Country	69/70/71	79/80/81	82	83
Austria	0.8	1.5	1.4	1.6
Belgium	24.9	33.7	34.2	36.4
France	2.2	3.4	3.6	2.7
Germ. FR	15.1	10.7	13.0	12.9
Italy	1.4	0.6	0.2	0.5
Portugal		0.3	0.2	
Spain		6.7	3.5	3.4
Sweden	0.4			
UK	15.8	12.0	10.9	15.7
Yugosl.		5.3	3.5	1.0
USA	36.7	11.4	17.0	15.4
Japan		14.4	12.5	10.4
DME	100	100	100	100
LDC	0.0	0.0	0.0	0.0
Total	100	100	100	100

Sources: World Metal Statistics and Metall Statistik

TABLE 6.2.3

World trade unrefined copper, imports annual average growth rate

50/60	60/70	70/80	50/80
	3.9	4.2	
		0.1	
- 4.1	8.6	1.6	1.9
	2.5	- 8.4	
	-13.5		
		- 1.3	
		-12.5	
	6.9		
- 0.3	-10.4	5.5	-1.9
		8.2	
5.7	- 3.7	-10.2	-3.0
		- 0.5	
		1.1	
		1.1	

TABLE 7.1.1

World trade in refined copper, exports (in 1000 MT)

Country		49/50/51	59/60/61	69/70/71	79/80/81	82	83
DME	Austria	0.9	1.2	5.5	18.9	17.2	21.3
	Belgium	117.8 [1,2)]	-	274.3	293.1	287.9	221.2
	Finland	-	-	5.7	2.9	4.4	11.7
	France	-	6.5	4.3	14.8	5.9	17.6
	Germany FR	31.7	83.3	114.3	79.7	71.5	90.0
	Netherl.	0.3 [1)]	0.9 [1)]	1.3	3.0	1.3	0.3
	Norway	-	-	24.3	23.3	18.1	20.3
	Spain	-	-	12.1	53.6	68.0	71.5
	Sweden	5.0 [1)]	15.4	28.0	20.1	28.4	23.3
	UK	0.5	79.3	47.1	27.0	17.4	16.7
	Yugosl.	-	-	30.4	32.1	7.3	3.5
	Canada	109.9 [1)]	231.9 [1)]	246.4	276.7	232.6	298.5
	S. Africa	-	-	28.6	64.9	66.4	91.6
	Japan	22.9 [1)]	1.5	24.3	97.0	44.6	177.5
	Australia	-	13.3	37.8	51.2	44.3	79.3
	USA	125.4	310.5	188.9	50.0	31.6	82.0
LDC	Zaïre	87.3	131.5	187.3	125.0	156.6	218.5
	Zambia	81.2	385.8	574.8	598.6	602.6	570.5
	Chile	328.2 [1)]	216.5	434.4	755.8	808.5	830.3
	Peru	20.9	27.9	31.1	204.5	204.1	161.8
DME		-	-	1316.4	1094.4	947.9	1251.6
LDC		-	-	1227.6	1683.9	1771.2	1781.1
Total		-	-	2544.0	2778.3	2719.1	3032.7

Source: Metall Statistik and World Metal Statistics

1) Includes unrefined

2) Includes Luxembourg

TABLE 7.1.2

World trade in refined copper, exports (percent. shares)

Country	69/70/71	79/80/81	82	83
DME Austria	0.2	0.7	0.6	0.7
Belgium	10.8	10.5	10.6	7.3
Finland	0.2	0.1	0.2	0.4
France	0.2	0.5	0.2	0.6
Germany FR	4.5	2.9	2.6	3.0
Netherl.	0.1	0.1	-	-
Norway	1.0	0.8	0.7	0.7
Spain	0.5	0.9	2.5	2.4
Sweden	1.1	0.7	1.0	0.8
UK	1.9	1.0	0.6	0.6
Yugosl.	1.2	1.2	0.3	0.1
Canada	9.7	10.0	8.6	9.8
USA	7.4	1.8	1.2	2.7
S.Africa	1.1	2.3	2.4	3.0
Japan	1.0	3.5	1.6	5.9
Australia	1.5	1.8	1.6	2.6
LDC Zaïre	7.4	4.5	5.8	7.2
Zambia	22.6	21.5	22.2	18.8
Chile	17.1	27.2	29.7	27.4
Peru	1.2	7.4	7.5	5.3
DME	51.7	39.4	34.9	41.3
LDC	48.3	60.6	65.1	58.7
Total	100	100	100	100

Source: Metall Statistik and World Metal Statistics

TABLE 7.1.3

Annual average growth rates

50/60	60/70	70/80	50/80
2.9	1.8	13.1	10.7
		0.7	
		- 6.5	
		13.2	
10.1	3.2	- 3.5	3.1
		- 18.9	
		16.0	
	6.2	- 3.3	
66.0	- 5.1	- 5.4	14.2
		0.5	
		1.2	3.1
9.5	- 4.8	- 12.4	- 3.0
		8.5	
	32.1	14.8	
	11.0	3.1	
4.2	3.6	- 4.0	2.0
16.9	4.1	0.4	6.9
	7.2	5.7	
2.9	1.1	20.7	7.9
		1.8	
		3.2	
		0.9	

TABLE 7.2.1

World trade in refined copper, imports (in 1000 MT)

Country	49/50/51	59/60/61	69/70/71	79/80/81	82	83
Austria	4.4	18.2	25.1	4.3	4.9	1.3
Belgium	152.0[1,2)]		186.2	312.9	255.3	141.7
Denmark				2.1	-	0.3
Finland			10.7	18.4	18.4	18.7
France	101.3	196.8	313.4	382.3	367.3	339.0
Germany FR	55.3	301.2	379.1	430.2	423.2	403.8
Greece				22.6	17.7	19.3
Italy	57.1 [1)]	157.7	254.3	342,8	318.9	297.2
Netherlands	11.1 [1)]	29.5 [1)]	41.3	23.8	20.6	25.6
Spain	3.4 [1)]		24.1	21.2	11.6	19.8
Sweden	38.3 [1)]	65.0	62.7	68.6	73.7	71.5
UK	212.1	394.3	397.6	268.1	255.4	200.7
Yugoslavia			23.6	27.0	23.3	18.0
Canada			16.5	23.6	28.0	24.6
USA	262.7	128.1	129.1	342.7	284.8	483.0
S. Africa			3.4	1.8	0.2	0.2
Japan	-	59.4 [1)]	172.6	258.1	295.8	190.4
Brazil			58.6	183.8	204.7	56.4
India			46.2	51.6	56.7	61.3
S. Korea				17.3	30.1	35.1
Taiwan				52.8	26.5	61.8
China				89.3	110.9	485.9
DME			2075.4	2507.4	2418.5	2270.5
LDC			104.8	309.2	320.5	216.6
Total ME			2180.2	2816.6	2739.0	2487.1

Source: World Metal Statistics and Metall Statistik

1) Inculdes blister

2) Includes Luxembourg

TABLE 7.2.2

World trade in refined copper, import (percent.shares of ME

Country	69/70/71	79/80/81	82	83
Austria	1.2	0.1	0.2	
Belgium	8.5	10.5	9.0	5.7
Denmark		0.1		
Finland	0.5	0.6	0.6	0.8
France	14.4	12.9	12.9	13.6
Germany FR	17.4	14.5	14.9	16.2
Greece		0.8	0.6	0.8
Italy	254.3	11.5	11.2	11.9
Netherl.	1.9	0.8	0.7	1.0
Spain	1.1	0.7	0.4	0.8
Sweden	2.9	2.3	2.6	2.9
UK	18.2	9.0	9.0	8.1
Yugosl.	1.1	0.9	0.8	0.7
Canada	0.8	0.8	1.0	1.0
USA	5.9	11.5	10.0	19.4
S. Africa	0.2	0.1		
Japan	7.9	8.7	10.4	7.7
Brazil	2.7	6.2	7.2	2.3
India	2.1	1.7	2.0	2.5
S. Korea		0.6	1.1	1.4
Taiwan		1.8	0.9	
China		3.0	3.9	19.5
DME	95.2	89.0	88.3	91.3
LDC	4.8	11.0	11.7	8.7
Total ME	100	100	100	100

Source: World Metal Statistics and Metall Statistik

TABLE 7.2.3

Annual average growth rates

50/60	60/70	70/80	50/80
15.3	3.3	- 16.2	- 0.1
		5.3	
		5.6	
6.9	4.8	2.0	4.5
18.5	2.3	1.3	7.1
	4.9	3.0	
		- 5.4	
		- 1.3	
	- 0.4	0.9	
6.4	0.1	- 3.9	0.8
		1.4	
		3.6	
-6.9	0.1	10.3	0.9
		- 6.2	
		4.1	
		12.1	
		1.1	
		2.2	
		14.3	
		3.1	

TABLE 8.1

World refined consumption (in 1000 MT)

	Country	49/50/51 1)	59/60/61 1)	69/70/71 2)	79/80/81 2)	82 2)	83 2)
DME	Austria	11.6	28.3	39.8	23.7	29.3	21.9
	Belgium 3)	58.3	82.8	111.7	289.0	277.1	258.2
	Finland	13.6	29.9	32.0	54.4	57.2	65.5
	France	130.2	225.5	336.4	407.1	419.0	390.0
	Germ. FR	171.5	508.3	661.2	763.1	730.1	737.0
	Italy	67.1	175.7	260.7	368.7	342.0	325.0
	Netherl.	10.8	29.1	39.7	29.8	29.2	26.3
	Portugal	-	-	10.0	17.1	14.2	12.3
	Spain	17.6	48.7	102.6	122.5	120.3	122.5
	Sweden	57.2	87.7	88.8	106.4	107.7	113.0
	Switzerl.	20.7	40.9	42.0	14.3	7.8	6.8
	UK	406.7	525.2	537.3	413.7	355.4	358.0
	Yugosl.	20.6	41.5	73.7	130.1	142.9	133.5
	Total Europe	996.0	1852.0	2357.4	2771.5	2656.5	2599.6
	Canada	103.4	117.1	223.7	231.1	148.9	195.0
	USA	1200.8	1293.0	1875.6	2020.6	1661.2	1775.4
	N.America	1304.2	1410.7	2099.3	2251.7	1810.1	1970.4
	Australia	35.2	66.6	106.0	127.5	131.0	114.8
	Japan	68.1	298.6	815.7	1247.5	1243.0	1216.3
	S. Africa	16.8	24.7	37.3	82.9	80.6	73.6
	Total 4)	2420.3	3652.6	5416.2	6482.7	5921.9	5975.1
LDC	Algeria	-	-	1.7	3.4	7.2	2.0
	Egypt	-	-	-	9.7	8.1	9.0
	Zaïre	-	-	-	2.4	1.6	1.8
	Zambia	-	-	-	2.0	2.8	1.1
	Zimbabwe	-	-	3.3	7.3	6.0	8.1
	Other Africa 5)	7.3	9.0	7.7	-	0.5	0.2
	Total Africa 6)	7.3	9.0	12.7	24.8	26.2	22.2
	India	31.0	61.4	54.0	73.4	83.2	96.0
	Iran	-	-	-	2.4	3.4	10.0
	Philipp.	-	-	-	3.4	3.6	5.0
	S. Korea	-	-	-	104.4	138.1	152.3
	Taiwan	-	-	-	82.2	73.9	104.8
	Turkey	-	-	12.1	26.9	32.4	57.9
	Other Asia 5,7)	4.8	18.2	-	22.2	30.0	47.2
	Dev. Asia	35.8	79.6	84.8	314.9	364.6	473.2
	Argentina	7.1	20.8	32.0	54.1	51.5	36.7
	Brazil	21.7	29.1	62.8	215.8	249.3	148.4
	Chile	30.8	22.1	22.3	43.6	32.8	23.8
	Mexico	11.1	18.9	59.6	122.7	88.4	79.2
	Peru	-	-	3.9	18.7	21.0	18.3
	Other Lat. Am.	0.6	2.1	2.1	12.2	3.3	3.3
	Lat. Am.	71.3	93.0	182.7	464.4	446.3	309.7
	Total	114.4	181.6	280.4	804.1	837.1	805.1
CPE	Bulgaria	-	-	-	57.0	60.0	62.0
	Czechsl.	-	-	-	87.9	90.0	85.0
	Germ. FR	25.3	61.7	90.0	121.3	123.0	115.0
	Poland	-	-	-	199.9	171.9	176.6
	Romania	-	-	-	81.0	75.0	68.0
	USSR	321.7	646.8	973.3	1326.7	1340.0	1360.0
	China and oth.Asia	4.4	106.7	210.0	379.3	415.0	428.0
	Total	391.1	899.5	1463.3	2283.7	2306.9	2333.0
CIPEC 8)		-	-	-	66.7	58.2	45.0
ME		2534.7	3834.2	5696.4	7286.7	6759.0	6780.2
World		2925.8	4733.7	7159.7	9570.4	9065.9	9113.2

Source: World Metal Statistics and Metall Statistik

1) Source: Metall Statistik
2) Source: World Metal Statistics
3) Data from Metall Statistik
4) Including New Zealand
5) Comp. of restgr.is not the same in all per. (considered
6) Excluding South Africa
7) Excluding Japan

TABLE 8.2

World refined consumption as percentage share of ME

Country		49/51 1)	54/61 1)	69/71 2)	78/81 2)	82 2)	83 2)
DME	Austria	0.5	0.7	0.7	0.3	0.4	0.3
	Belg.[3]	2.3	2.2	2.0	4.0	4.1	3.8
	Finland	0.5	0.8	0.6	0.8	0.8	1.0
	France	5.1	5.9	5.9	6.8	6.2	5.8
	Germ. FR	6.8	13.3	11.0	10.5	10.8	10.9
	Italy	2.6	6.4	4.6	5.1	5.1	4.8
	Netherl.	0.4	0.8	0.7	0.4	0.4	0.4
	Portugal	-	-	0.2	0.2	0.2	0.2
	Spain	0.7	1.3	1.8	1.7	1.8	1.8
	Sweden	2.3	2.3	1.6	1.5	1.6	1.7
	Switerl.	0.8	1.1	0.7	0.2	0.1	0.1
	UK	16.0	13.7	9.4	5.7	5.3	5.3
	Yugosl.	0.8	1.1	1.3	1.8	2.1	2.0
	Tot. Eur.	39.3	48.3	41.4	38.0	39.3	38.3
	Canada	4.1	3.1	3.9	3.2	2.2	2.9
	USA	47.4	33.7	32.9	27.7	24.6	26.2
	N.America	51.5	36.8	36.9	30.9	26.8	29.1
	Australia	1.4	1.7	1.9	1.7	1.9	1.7
	Japan	2.7	7.8	14.3	17.1	18.4	17.9
	S. Africa	0.7	0.6	0.7	1.1	1.2	1.1
	Total [4]	95.5	95.3	95.1	89.0	87.6	88.1
LDC	Algeria	-	-	-	-	0.1	-
	Egypt	-	-	-	0.1	0.1	0.1
	Zimbabwe	-	-	0.1	0.1	0.1	0.1
	Other Afr. [5]	0.3	0.2	0.1	-	-	-
	Total Afr. [6]	0.3	0.2	0.2	0.3	0.4	0.3
	India	1.2	1.6	0.9	1.0	1.2	1.4
	Iran	-	-	-	-	0.1	0.1
	Philipp.	-	-	-	-	0.1	0.1
	S. Korea	-	-	-	1.4	2.0	2.2
	Taiwan	-	-	-	1.1	1.1	1.5
	Turkey	-	-	0.2	0.4	0.5	0.9
	Other Asia [5,7]	0.2	0.5	-	0.3	0.4	0.7
	Dev. Asia	1.4	2.1	1.5	4.3	5.4	7.0
	Argentina	0.3	0.5	0.6	0.7	0.8	0.5
	Brazil	0.9	0.8	1.1	3.0	3.7	2.2
	Chile	1.2	0.6	0.4	0.6	0.5	0.4
	Mexico	0.4	0.5	1.0	1.7	1.3	1.2
	Peru	-	-	0.1	0.3	0.3	0.3
	Other Lat. Am.	-	0.1	-	0.2	-	-
	Lat. Am.	2.8	2.4	3.2	6.4	6.6	4.6
	Total	4.5	4.7	4.9	11.0	12.4	11.9
CPE	Bulgaria	-	-	-	0.8	0.9	0.9
	Czechosl.	-	-	-	1.2	1.3	1.3
	Germ. FR	1.0	1.6	1.6	1.7	1.8	1.7
	Poland	-	-	-	2.7	2.5	2.6
	Romania	-	-	-	1.1	1.1	1.0
	USSR	12.7	16.9	17.1	18.2	19.8	20.1
	China and oth.Asia	0.2	2.8	3.7	5.2	6.1	6.3
	Total	15.4	23.5	25.7	31.3	34.1	34.4
CIPEC [8]		-	-	-	0.9	0.9	0.7
ME		100	100	100	100	100	100
World		115.4	123.5	125.7	131.2	134.1	134.4

Source: World Metal Statistics and Metall Statistik
1) Source: Metall Statistik
2) Source: World Metal Statistics
3) Data from Metall Statistik
4) Including New Zealand
5) Comp.of restgr. os not the same in all per. (considered
6) Excluding South Africa
7) Excluding Japan

TABLE 8.3

World refined consumption, average annual growth rates

Country		50/60 [1]	60/70 [2]	70/80 [2]	50/80 [1,2]
DME	Austria	9.3	3.5	- 5.1	2.4
	Belgium [3]	3.6	3.0	10.0	5.3
	Finland	8.2	0.7	5.5	4.9
	France	5.6	4.1	1.9	3.9
	Germany FR	11.5	2.7	1.4	5.1
	Italy	10.1	4.0	3.5	5.8
	Netherlands	10.4	3.2	- 2.8	3.4
	Spain	10.7	7.7	1.8	6.7
	Sweden	4.4	6.1	1.8	2.1
	Switzerland	7.0	0.3	- 10.2	- 1.2
	UK	2.6	0.2	- 2.6	0.1
	Yugoslavia	7.3	5.9	5.9	6.3
	Total Europe	6.4	2.4	1.6	3.5
	Canada	1.3	6.6	0.3	2.7
	USA	0.7	3.8	0.7	1.7
	N. America	0.8	4.1	0.7	1.8
	Australia	6.6	4.8	1.9	4.4
	Japan	15.9	10.6	4.3	10.2
	South Africa	3.9	4.2	8.3	5.5
	Total [4]	4.2	4.0	1.8	3.3
LDC	Algeria	-	-	7.2	-
	Zimbabwe	-	-	8.3	-
	Other Afr. [5]	2.1	- 1.5	- 100	- 100
	Tot. Afr. [6]	2.1	3.5	6.9	4.4
	India	7.1	- 1.3	3.1	2.9
	Turkey	-	-	8.3	-
	Other Asia [5,7]	14.3	-	-	5.2
	Dev. Asia	8.3	0.6	14.0	7.5
	Argentina	11.3	4.4	5.4	7.0
	Brazil	3.0	8.0	13.1	8.0
	Chile	- 3.3	0.1	6.9	1.2
	Mexico	5.5	12.2	7.5	8.3
	Peru	-	-	17.0	-
	Other Lat. Am.	-	-	19.2	10.6
	Lat. America	2.7	7.0	9.8	6.4
	Total	4.7	4.4	11.1	6.7
CPE	Germany DR	9.3	3.8	3.0	5.4
	USSR	7.8	4.2	3.1	4.8
	China and other Asia	37.6	7.0	6.1	16.0
	Total	8.7	5.0	4.6	6.1
CIPEC [8]					
ME		4.2	4.0	2.5	3.6
World		4.9	4.2	2.9	4.0

Source: World Metal Statistics and Metall Statistik

1) Source: Metall Statistik
2) Source: World Metal Statistics
3) Data from Metall Statistik
4) Including New Zealand
5) Composition of restgroups is not the same in all periods considered
6) Excluding South Africa
7)
8)

TABLE 9

Production of copper semis in developing countries; consumption of refined and production data (x 1000 tons and percentage shares)

Country	Refined consumption			Production data	
	1969/71 Volume	1979/81 Volume	%	1969/71 Volume	1979/81 Volume
Argentina	32.0	54.1	6.7	n.a.	n.a.
Brazil	62.8	215.8	26.8	97.3	209.2
Chile	22.3	43.6	5.4	9.1	n.a. *)
Mexico	59.6	122.7	15.3	n.a.	177.3
Peru	3.9	18.7	2.3	n.a.	-
Other L.A.	2.1	12.2	1.5	n.a.	-
Lat.America	182.7	464.4	57.8	n.a.	n.a.
Algeria	1.7	3.4	0.4	n.a.	n.a.
Egypt	-	9.7	1.2	-	n.a.
Zaïre	-	2.4	0.3	-	n.a.
Zambia	-	2.0	0.2	-	n.a.
Zimbabwe	3.3	7.3	0.9	n.a.	n.a.
Other Africa	7.7	-	-	n.a.	n.a.
Africa	12.7	24.8	3.1	n.a.	n.a.
India	54.0	73.4	9.1	n.a.	n.a.
Iran	-	2.4	0.3	-	n.a.
Philippines	-	3.4	0.4	-	n.a.
South Korea	-	104.4	13.0	-	81.3
Taiwan	-	82.2	10.2	-	67.2
Turkey	12.1	26.9	3.3	n.a.	n.a.
Other Asia	-	22.2	2.8	-	n.a.
Asia	84.8	314.9	39.0	n.a.	n.a.
Total	280.4	804.1	100	n.a.	n.a.
Direct scrap	101.1	198.7			
TOTAL	381.5	1002.8			

Source: Statistical Annex and World Metal Statistics

*) The most recent figure available is 38.6 thousand tons in 1979

REFERENCES

Balon, R.: "The copper semis industry", in Copper 1983, London, 1983

Banks, F.: "The world copper market: an economic analysis", Ballinger, Cambridge, 1974

Becker, D.: "The new bourgeoisie and the limits of dependency: mining, class, and power, in 'Revolutionary' Peru", Princeton University Press, Princeton, New Jersey, 1983

Bureau of Mines: "Copper 1983", Washington, 1984

Gluschke, W., J. Shaw and B. Varon: "Copper: the next fifteen years", Reidel, Holland, 1979

Gueronik, S.R.: "Cipec and Semis", in Metal Bulletin, Special issue on copper, 1974

International Wrought Copper Council: "Annual Report 1983-4", London, 1984

Kirthisingha, P.: "Viability of processing in copper-mining areas; an economic analysis", in Resources Policy, December 1982

Labys, W.: "Market Structures, Bargaining Power, and Resource Price Formation", Lexington Books, Lexington, 1980

Mardones, J.L., E. Silva and Ch. Martinez: "The copper and aluminium industries", in Resources Policy, March 1985

Mezger, D.: "Copper in the world economy", Heinemann, London, 1980

Mikdashi, Z.: "The international politics of natural resources", Cornell University Press, Ithaca, 1976

Mikesell, R.: "The World Copper Industry; structure and economic analysis", Johns Hopkins, Baltimore, 1979

Moran, Th.: "Copper in Chile", Princeton University Press, Princeton, 1974

OECD: "The Generalised System of Preferences: review of the first decade", Paris, 1983

Perlman, R.: "Kupferverbrauch in Entwicklungsländern", in Metall, Januar 1982

Prain, R.: "Copper, the anatomy of an industry", Mining Journal Books, London, 1975

Radetzki, M.: "Where should developing countries' minerals be processed ? The country view versus the multinational company view", in World Development, Vol. 5, 1977, No. 4

Radetzki, M.: "Market structure and bargaining power; a study of three international mineral markets", in Resources Policy, June 1978

Radetzki, M.: "Has political risk scared mineral investment away from the deposits in developing countries ?", in World Development, Vol. 10, no. 1, 1982

Roemer, M.: "Resource-based industrialization in the developing countries", in The Journal of Development Economics, 6, 1979

Sheer, H.: "Der Markt für Halbzeug aus Kupfer und -legierungen in Europa und Übersee", in Metall, November 1981

Takeuchi K. and Ch. Ching: "Export-oriented processing of primary commodities in developing countries", World Bank, September 1979 (Mimeo)

Toye, J.: "The recession, the third world and base metal industries", in World Development, Vol. 12, No. 9, 1984

United Nations, Centre on transnational corporations: "Transnational corporations in the copper industry", New York, 1981

UNIDO: "Transnational corporations and the processing of raw materials: impact on developing countries", ID/B/209, 1978

UNCTAD: "Processing and marketing of copper: areas for international co-operation", New York, 1982

Vingerhoets, J. and A. Sannen: "Fabrication of copper semi-manufactures in Zambia", Tilburg, 1985

Wall, D.: "Industrial processing of natural resources", in World Development, Vol. 8, 1980, p. 309

Zorn, S.: "Mining and mineral processing in developing countries", UNIDO, 1985 (Mimeo)

STATISTICS

Commodity Trade Statistics; United Nations, New York

Eurostat, analytical tables of foreign trade; EEC, Brussels

Metallstatistik; Metallgesellschaft, Germany FR

World Metal Statistics; World Bureau of Metal Statistics, London

World Trade in Copper and Copper Alloy Semi-manufactures, 1981, International Wrought Copper Council, 1983

Yearbook of International Trade Statistics; United Nations, New York

PERIODICALS

Copper Studies, a CRU publication

Metal Bulletin Monthly

Metall, a Metallgesellschaft publication

Resources Policy

IN 1985 REEDS VERSCHENEN

168 T.M. Doup, A.J.J. Talman
A continuous deformation algorithm on the product space of unit simplices

169 P.A. Bekker
A note on the identification of restricted factor loading matrices

170 J.H.M. Donders, A.M. van Nunen
Economische politiek in een twee-sectoren-model

171 L.H.M. Bosch, W.A.M. de Lange
Shift work in health care

172 B.B. van der Genugten
Asymptotic Normality of Least Squares Estimators in Autoregressive Linear Regression Models

173 R.J. de Groof
Geïsoleerde versus gecoördineerde economische politiek in een twee-regiomodel

174 G. van der Laan, A.J.J. Talman
Adjustment processes for finding economic equilibria

175 B.R. Meijboom
Horizontal mixed decomposition

176 F. van der Ploeg, A.J. de Zeeuw
Non-cooperative strategies for dynamic policy games and the problem of time inconsistency: a comment

177 B.R. Meijboom
A two-level planning procedure with respect to make-or-buy decisions, including cost allocations

178 N.J. de Beer
Voorspelprestaties van het Centraal Planbureau in de periode 1953 t/m 1980

178a N.J. de Beer
BIJLAGEN bij Voorspelprestaties van het Centraal Planbureau in de periode 1953 t/m 1980

179 R.J.M. Alessie, A. Kapteyn, W.H.J. de Freytas
De invloed van demografische factoren en inkomen op consumptieve uitgaven

180 P. Kooreman, A. Kapteyn
Estimation of a game theoretic model of household labor supply

181 A.J. de Zeeuw, A.C. Meijdam
On Expectations, Information and Dynamic Game Equilibria

182 Cristina Pennavaja
Periodization approaches of capitalist development.
A critical survey

183 J.P.C. Kleijnen, G.L.J. Kloppenburg and F.L. Meeuwsen
Testing the mean of an asymmetric population: Johnson's modified T test revisited

184 M.O. Nijkamp, A.M. van Nunen
Freia versus Vintaf, een analyse

185 A.H.M. Gerards
Homomorphisms of graphs to odd cycles

186 P. Bekker, A. Kapteyn, T. Wansbeek
Consistent sets of estimates for regressions with correlated or uncorrelated measurement errors in arbitrary subsets of all variables

187 P. Bekker, J. de Leeuw
The rank of reduced dispersion matrices

188 A.J. de Zeeuw, F. van der Ploeg
Consistency of conjectures and reactions: a critique

189 E.N. Kertzman
Belastingstructuur en privatisering

190 J.P.C. Kleijnen
Simulation with too many factors: review of random and group-screening designs

191 J.P.C. Kleijnen
A Scenario for Sequential Experimentation

192 A. Dortmans
De loonvergelijking
Afwenteling van collectieve lasten door loontrekkers?

193 R. Heuts, J. van Lieshout, K. Baken
The quality of some approximation formulas in a continuous review inventory model

194 J.P.C. Kleijnen
Analyzing simulation experiments with common random numbers

195 P.M. Kort
Optimal dynamic investment policy under financial restrictions and adjustment costs

196 A.H. van den Elzen, G. van der Laan, A.J.J. Talman
Adjustment processes for finding equilibria on the simplotope

197 J.P.C. Kleijnen
Variance heterogeneity in experimental design

198 J.P.C. Kleijnen
Selecting random number seeds in practice

199 J.P.C. Kleijnen
Regression analysis of simulation experiments: functional software specification

200 G. van der Laan and A.J.J. Talman
An algorithm for the linear complementarity problem with upper and lower bounds

201 P. Kooreman
Alternative specification tests for Tobit and related models

IN 1986 REEDS VERSCHENEN

202 J.H.F. Schilderinck
Interregional Structure of the European Community. Part III

203 Antoon van den Elzen and Dolf Talman
A new strategy-adjustment process for computing a Nash equilibrium in a noncooperative more-person game